E/ECE/324
E/ECE/TRANS/505 } Add.9/Rev.2

8 December 1997

AGREEMENT

CONCERNING THE ADOPTION OF UNIFORM TECHNICAL PRESCRIPTIONS FOR WHEELED VEHICLES, EQUIPMENT AND PARTS WHICH CAN BE FITTED AND/OR BE USED ON WHEELED VEHICLES AND THE CONDITIONS FOR RECIPROCAL RECOGNITION OF APPROVALS GRANTED ON THE BASIS OF THESE PRESCRIPTIONS */

(Revision 2, including the amendments entered into force on 16 October 1995)

Addendum 9: Regulation No. 10

Revision 2

Incorporating:

01 series of amendments - Date of entry into force: 19 March 1978
02 series of amendments - Date of entry into force: 3 September 1997

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF VEHICLES WITH REGARD TO ELECTROMAGNETIC COMPATIBILITY

UNITED NATIONS

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*/ Former title of the Agreement:

Agreement Concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, done at Geneva on 20 March 1958.

GE.97-24886

Regulation No. 10

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF VEHICLES WITH REGARD TO ELECTROMAGNETIC COMPATIBILITY

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1. SCOPE

This Regulation applies to the electromagnetic compatibility of M, N and O categories of vehicles (hereinafter referred to as vehicle(s)) as supplied by the vehicle manufacturer and to components or separate electrical/electronic technical units intended for fitment in vehicles.

2. DEFINITIONS

For the purposes of this Regulation:

2.1. "Electromagnetic compatibility" means the ability of a vehicle or component(s) or separate electrical/electronic technical unit(s) to function satisfactorily in an electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

2.2. "Electromagnetic disturbance" means any electromagnetic phenomenon which may degrade the performance of a vehicle or component(s) or separate electrical/electronic technical unit(s). An electromagnetic disturbance may be electromagnetic noise or a change in the propagation medium itself.

2.3. "Electromagnetic immunity" means the ability of a vehicle or component(s) or separate technical unit(s) to perform without degradation of performance in the presence of specified electromagnetic disturbances.

2.4. "Electromagnetic environment" means the totality of electromagnetic phenomena existing at a given location.

2.5. "Reference limit" means the nominal level to which type approval and conformity of production limit values are referenced.

2.6. "Reference antenna" for the frequency range 20 to 80 MHz: means a balanced half-wave resonant dipole at 80 MHz, and for the frequency range above 80 MHz: means a balanced half-wave resonant dipole tuned to the measurement frequency.

2.7. "Broadband electromagnetic disturbances" means electromagnetic disturbances which have a bandwidth greater than the passband of the receiver used.

2.8. "Narrowband electromagnetic disturbances" means electromagnetic disturbances which have a bandwidth less than the passband of the receiver used.

2.9. "Electrical/electronic system" means an electrical and or electronic device or set of devices together with any associated electrical wiring which forms part of a vehicle but which is not

intended to be type approved separately from the vehicle. (The vehicle is type approved as a complete unit, see para. 3.1. of this Regulation.)

2.10. "Electrical/electronic sub-assembly" (ESA) means an electrical and/or electronic device or set of devices intended to be part of a vehicle, together with any associated electrical wiring, which performs one or more specialized functions. An ESA may be approved at the request of a manufacturer as either a "component" or a "separate technical unit (STU)".

2.11. "Vehicle type" in relation to electromagnetic compatibility, means vehicles which do not differ essentially in such respects as:

2.11.1. the overall size and shape of the engine compartment;

2.11.2. the general arrangement of the electrical and/or electronic components and the general wiring arrangement;

2.11.3. the primary material of which the body or shell (if applicable) of the vehicle is constructed (for example, a steel, aluminium or fibreglass body shell). The presence of panels of different material does not change the vehicle type provided the primary material of the body is unchanged. However, such variations must be notified.

2.12. An "ESA type" in relation to electromagnetic compatibility, means ESAs which do not differ in such essential respects as:

2.12.1. the function performed by the ESA;

2.12.2. the general arrangement of the electrical and/or electronic components.

3. APPLICATION FOR APPROVAL

3.1. Approval of a vehicle type

3.1.1. The application for approval of a vehicle type, with regard to its electromagnetic compatibility, shall be submitted by the vehicle manufacturer.

3.1.2. A model of information document is shown in annex 2A.

3.1.3. The vehicle manufacturer shall draw up a schedule describing all projected combinations of relevant vehicle electrical/electronic systems or ESAs, body styles (where applicable), variations in body material (where applicable), general wiring arrangements, engine variations, left-hand/right-hand drive versions and wheelbase versions. Relevant vehicle electrical/electronic systems or ESAs are those which may emit significant broadband or narrowband disturbances and/or those which involve the driver's direct control (see para. 6.4.2.3. of this Regulation) of the vehicle.

3.1.4. A vehicle representative of the type to be approved shall be selected from this schedule by mutual agreement between the manufacturer and the competent authority. The choice of vehicle shall be based on the electrical/electronic systems offered by the manufacturer. One or more vehicles may be selected from this schedule if it is considered by mutual agreement between the manufacturer and the competent authority that different electrical/electronic systems are included which are likely to have a significant effect on the vehicle's electromagnetic compatibility compared with the first representative vehicle.

3.1.5. The choice of the vehicle(s) in conformity with paragraph 3.1.4. above shall be limited to vehicle/electrical/electronic system combinations intended for actual production.

3.1.6. The manufacturer may supplement the application with a report on tests which have been carried out. Any such data provided may be used by the approval authority for the purpose of drawing up the communication form for type-approval.

3.1.7. If the technical service responsible for the type approval test carries out the test itself, then a vehicle representative of the type to be approved according to paragraph 3.1.4. shall be provided.

3.2. ESA type approval

3.2.1. The application for approval of a type of ESA with regard to its electromagnetic compatibility shall be submitted by the vehicle manufacturer or by the manufacturer of the ESA.

3.2.2. A model of information document is shown in annex 2B.

3.2.3. The manufacturer may supplement the application with a report on tests which have been carried out. Any such data provided may be used by the approval authority for the purpose of drawing up the communication form for type-approval.

3.2.4. If the technical service responsible for the type approval test carries out the test itself, then a sample of the ESA system representative of the type to be approved shall be provided, if necessary, after discussion with the manufacturer on, e.g., possible variations in the layout, number of components, number of sensors. If the technical service deems it necessary, it may select a further sample.

3.2.5. The sample(s) must be clearly and indelibly marked with the manufacturer's trade name or mark and the type designation.

3.2.6. Where applicable, any restrictions on use should be identified. Any such restrictions should be included in annexes 2B and/or 3B.

4. APPROVAL

4.1. Type approval procedures

4.1.1. Type approval of a vehicle

The following alternative procedures for vehicle type approval may be used at the discretion of the vehicle manufacturer.

4.1.1.1. Approval of a vehicle installation

A vehicle installation may be type approved directly by following the provisions laid down in paragraph 6 of this Regulation. If this procedure is chosen by a vehicle manufacturer, no separate testing of electrical/electronic systems or ESAs is required.

4.1.1.2. Approval of vehicle type by testing of individual ESAs

A vehicle manufacturer may obtain approval for the vehicle by demonstrating to the approval authority that all the relevant (see para. 3.1.3. of this Regulation) electrical/electronic systems or ESAs have been approved in accordance with this Regulation and have been installed in accordance with any conditions attached thereto.

4.1.1.3. A manufacturer may, if he wishes, obtain approval for the purposes of this Regulation if the vehicle has no equipment of the type which is subject to immunity or emission tests. The vehicle shall have no systems as specified in paragraph 3.1.3. (immunity) and no spark ignition equipment. Such approvals do not require testing.

4.1.2. Type approval of an ESA

Type approval may be granted to an ESA to be fitted either to any vehicle type or to a specific vehicle type or types requested by the manufacturer. ESAs involved in the direct control of vehicles will normally receive type approval by agreement with the vehicle manufacturer.

4.2. Granting of type approval

4.2.1. Vehicle

4.2.1.1. If the representative vehicle fulfils the requirements of paragraph 6 of this Regulation, type approval shall be granted.

4.2.1.2. A model of communication form for type approval is contained in annex 3A.

4.2.2. ESA

4.2.2.1. If the representative ESA system(s) fulfil(s) the requirements of paragraph 6 of this Regulation, type approval shall be granted.

4.2.2.2. A model of communication form for type approval is contained in annex 3B.

4.2.3. In order to draw up the communication forms referred to in paragraph 4.2.1.2. or 4.2.2.2. above, the competent authority of the Contracting Party granting the approval may use a report prepared or approved by a recognized laboratory or in accordance with the provisions of this Regulation.

4.3. Approval, or refusal of approval, of a type of vehicle or ESA in accordance with this Regulation shall be notified to the Parties to the Agreement applying this Regulation on a form conforming to the model in annex 3A or 3B of this Regulation, accompanied by photographs and/or diagrams or drawings on an appropriate scale supplied by the applicant in a format not larger than A4 (210 x 297 mm) or folded to those dimensions.

5. MARKINGS

5.1. An approval number shall be assigned to each vehicle or ESA type approved. The first two digits of this number (at present 02) shall indicate the series of amendments corresponding to the most recent essential technical amendments made to the Regulation at the date of approval. A Contracting Party may not assign the same approval number to another type of vehicle or ESA.

5.2. Presence of markings

5.2.1. Vehicle

An approval mark described in paragraph 5.3. below shall be affixed to every vehicle conforming to a type approved under this Regulation.

5.2.2. Sub-assembly

An approval mark described in paragraph 5.3. below shall be affixed to every ESA conforming to a type approved under this Regulation.

No marking is required for electrical/electronic systems built into vehicles which are approved as units.

5.3. An international approval mark must be affixed, in a conspicuous and easily accessible place specified on the approval communication form, on each vehicle conforming to the type approved under this Regulation. This mark shall comprise:

5.3.1. A circle containing the letter "E", followed by the distinguishing number of the country granting the approval. 1/

5.3.2. The number of this Regulation, followed by the letter "E", a dash and the approval number to the right of the circle specified in paragraph 5.3.1.

5.4. An example of the type-approval mark is shown in annex 1 to this Regulation.

5.5. Markings on ESAs in conformity with paragraph 5.3. above need not be visible when the ESA is installed in the vehicle.

6. SPECIFICATIONS

6.1. General specifications

6.1.1. A vehicle (and its electrical/electronic system(s) or ESAs) shall be so designed and fitted as to enable the vehicle, in normal conditions of use, to conform to the requirements of this Regulation.

6.2. Specifications concerning broadband electromagnetic disturbances generated by vehicles fitted with spark ignition.

6.2.1. Method of measurement

The electromagnetic disturbances generated by the vehicle representative of its type shall be measured using the method described in annex 4 at either of the defined antenna distances. The choice shall be made by the vehicle manufacturer.

6.2.2. Reference limit for broadband electromagnetic disturbances generated by the vehicle.

6.2.2.1. If measurements are made using the method described in annex 4 using a vehicle-to-antenna spacing of 10.0 ± 0.2 m, the radiation reference limit shall be 34 dB micro-Volts/m (50 micro-Volts/m) in the 30-75 MHz frequency band, increasing

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1/ 1 for Germany, 2 for France, 3 for Italy, 4 for the Netherlands, 5 for Sweden, 6 for Belgium, 7 for Hungary, 8 for the Czech Republic, 9 for Spain, 10 for Yugoslavia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 (vacant), 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal, 22 for the Russian Federation, 23 for Greece, 24 (vacant), 25 for Croatia, 26 for Slovenia, 27 for Slovakia, 28 for Belarus, 29 for Estonia, 30-36 (vacant) and 37 for Turkey. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement concerning the Recognition of Approval for Motor Vehicle Equipment and Parts, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

logarithmically (linearly) from 34 to 45 dB micro-Volts/m (50-180 micro-Volts/m) in the 75-400 MHz frequency band, (as shown in appendix 1 to this Regulation), and remaining constant at 45 dB micro-Volts/m (180 micro-Volts/m) in the 400-1,000 MHz frequency band.

2.2.2. If measurements are made using the method described in annex 4 using a vehicle-to-antenna spacing of 3.0 ± 0.05 m, the radiation reference limit shall be 44 dB micro-Volts/m (160 micro-Volts/m) in the 30-75 MHz frequency band, increasing logarithmically (linearly) from 44 to 55 dB micro-Volts/m (160-562 micro-Volts/m) in the 75-400 MHz frequency band, (as shown in appendix 2 to this Regulation), and remaining constant at 55 dB micro-Volts/m (562 micro-Volts/m) in the 400-1,000 MHz frequency band.

6.2.2.3. On the vehicle presented for approval, the measured values, expressed in dB micro-Volts/m, (micro-Volts/m), shall be at least 2.0 dB, (20 per cent) below the reference limit.

6.3. Specifications concerning narrowband electromagnetic disturbances generated by vehicles.

6.3.1. Method of measurement

The electromagnetic disturbances generated by the vehicle type presented for approval shall be measured using the method described in annex 5 at either of the defined antenna distances. The choice shall be made by the vehicle manufacturer.

6.3.2. Reference limit for narrowband electromagnetic disturbances generated by the vehicle.

6.3.2.1. If measurements are made using the method described in annex 5 using a vehicle-to-antenna spacing of 10.0 ± 0.2 m, the radiation reference limit shall be 24 dB micro-Volts/m (16 micro-Volts/m) in the 30-75 MHz frequency band, increasing logarithmically (linearly) from 24 to 35 dB micro-Volts/m (16-56 micro-Volts/m) in the 75-400 MHz frequency band, (as shown in appendix 3 to this Regulation), and remaining constant at 35 dB micro-Volts/m (56 micro-Volts/m) in the 400-1,000 MHz frequency band.

6.3.2.2. If measurements are made using the method described in annex 5 using a vehicle-to-antenna spacing of 3.0 ± 0.05 m, the radiation reference limit shall be 34 dB micro-Volts/m (50 micro-Volts/m) in the 30-75 MHz frequency band, increasing logarithmically (linearly) from 34 to 45 dB micro-Volts/m (50-180 micro-Volts/m) in the 75-400 MHz frequency band, (as shown in appendix 4 to this Regulation), and remaining constant at 45 dB micro-Volts/m (180 micro-Volts/m) in the 400-1,000 MHz frequency band.

6.3.2.3. On the vehicle presented for approval, the measured values, expressed in dB micro-Volts/m (micro-Volts/m), shall be at least 2.0 dB, (20 per cent) below the reference limit.

6.3.2.4. Notwithstanding the limits defined in paragraphs 6.3.2.1., 6.3.2.2. and 6.3.2.3. of this Regulation, if, during the initial step described in annex 5, paragraph 1.3, the signal strength measured at the vehicle radio antenna is less than 20 dB micro-Volts (10 micro-Volts) over the frequency range 88-108 MHz, then the vehicle shall be deemed to conform to the limits for narrowband electromagnetic disturbances and no further testing will be required.

6.4. Specifications concerning immunity of vehicles to electromagnetic radiation.

6.4.1. Method of testing

The immunity to electromagnetic radiation of the vehicle presented for approval shall be tested by the method described in annex 6.

6.4.2. Vehicle immunity reference limits.

6.4.2.1. If tests are made using the method described in annex 6, the field strength reference limit shall be 24 Volts/m r.m.s. in over 90 per cent of the 20 MHz to 1,000 MHz frequency band and 20 Volts/m r.m.s. over the whole 20 MHz to 1,000 MHz frequency band.

6.4.2.2. The vehicle representative of its type shall be considered as conforming to immunity requirements if, during the tests performed in accordance with annex 6, and subjected to a field strength, expressed in Volts/m, of 25% above the reference level, no abnormal change in the speed of the driving wheels of the vehicle, no degradation of performance which would cause confusion to other road users, and no degradation in the driver's direct control of the vehicle can be observed by the driver or other road users.

6.4.2.3. The driver's direct control of the vehicle is exercised by means of, for example, steering, braking, or engine speed control.

6.5. Specifications concerning broadband electromagnetic disturbances generated by ESAs.

6.5.1. Method of measurement

The electromagnetic radiation generated by the ESA representative of its type shall be measured by the method described in annex 7.

6.5.2. ESA broadband reference limit

6.5.2.1. If measurements are made using the method described in annex 7, the radiation reference limit shall decrease logarithmically (linearly) from 64 to 54 dB micro-Volts/m (1,600-500 micro-Volts/m) in the

30-75 MHz frequency band, and increase logarithmically (linearly) from 54 to 65 dB micro-Volts/m (500-1,800 micro-Volts/m) in the 75-400 MHz band, (as shown in appendix 5 to this Regulation) and remain constant at 65 dB micro-Volts/m (1,800 micro-Volts/m) in the 400-1,000 MHz frequency band.

6.5.2.2. On the ESA representative of its type, the measured values, expressed in dB micro-Volts/m, shall be at least 2.0 dB (20 per cent) below the reference limit.

6.6. Specifications concerning narrowband electromagnetic disturbances generated by ESAs.

6.6.1. Method of measurement

The electromagnetic disturbances generated by the ESA representative of its type shall be measured by the method described in annex 8.

6.6.2. Reference limits for narrowband electromagnetic disturbances generated by ESAs.

6.6.2.1. If measurements are made using the method described in annex 8, the radiation reference limit shall decrease logarithmically (linearly) from 54 to 44 dB micro-Volts/m (500-160 micro-Volts/m) in the 30-75 MHz frequency band, and increase logarithmically (linearly) from 44 to 55 dB micro-Volts/m (160-560 micro-Volts/m) in the 75-400 MHz band, (as shown in appendix 6 to this Regulation), and remain constant at 55 dB micro-Volts/m (560 micro-Volts/m) in the 400-1,000 MHz frequency band.

6.6.2.2. On the ESA representative of its type, the measured values, expressed in dB micro-Volts/m, shall be at least 2.0 dB (20 per cent) below the reference limit.

6.7. Specifications concerning immunity of ESAs to electromagnetic radiation.

6.7.1. Test method(s)

The immunity to electromagnetic radiation of the ESA represented for approval shall be tested by the method(s) chosen from among those described in annex 9.

6.7.2. ESA immunity reference limits

6.7.2.1. If tests are made using the methods described in annex 9, the immunity test reference levels shall be 48 Volts/m for the 150 mm stripline testing method, 12 Volts/m for the 800 mm stripline testing method, 60 Volts/m for the TEM cell testing method, 48 mA

for the bulk current injection (BCI) test method and 24 Volts/m for the free field test method.

6.7.2.2. On the ESA representative of its type at a field strength or current, expressed in appropriate linear units, 25 per cent above the reference limit, the ESA shall not exhibit any malfunction which would cause any degradation of performance which could cause confusion to other road users or any degradation in the driver's direct control of a vehicle fitted with the system.

6.8. Exceptions

6.8.1. Where a vehicle or electrical/electronic system or ESA does not include an electronic oscillator with an operating frequency greater than 9 kHz, it shall be deemed to conform to paragraphs 6.3.2. or 6.6.2. above and to annexes 5 and 8.

6.8.2. Vehicles which do not have electrical/electronic systems or ESAs involved in the direct control of the vehicle need not be tested for immunity and shall be deemed to conform to paragraph 6.4. above and to annex 6.

6.8.3. ESAs whose functions are not essential to the direct control of the vehicle need not be tested for immunity and shall be deemed to conform to paragraph 6.7. above and to annex 9.

6.8.4. Electrostatic discharge

For vehicles fitted with tyres, the vehicle body/chassis can be considered to be an electrically isolated structure. Significant electrostatic forces in relation to the vehicle's external environment occur only at the moment of occupant entry into or exit from the vehicle. As the vehicle is stationary at these moments, no type approval test for electrostatic discharge is necessary.

6.8.5. Conducted transients

Since during normal driving, no external electrical connections are made to vehicles, no conducted transients are generated in relation to the external environment. The responsibility of ensuring that equipment can tolerate the conducted transients within a vehicle, e.g. due to load switching and interaction between systems, lies with the manufacturer. No type approval test for conducted transients is deemed necessary.

7. AMENDMENT OR EXTENSION OF A VEHICLE TYPE APPROVAL FOLLOWING ESA ADDITION OR SUBSTITUTION

7.1. Where a vehicle manufacturer has obtained type approval for a vehicle installation and wishes to fit an additional or substitutional electrical/electronic system or ESA which has

already received approval under this Regulation, and which will be installed in accordance with any conditions attached thereto, the vehicle approval may be extended without further testing. The additional or substitutional electrical/electronic system or ESA shall be considered as part of the vehicle for conformity of production purposes.

7.2. Where the additional or substitutional part(s) has (have) not received approval pursuant to this Regulation, and if testing is considered necessary, the whole vehicle shall be deemed to conform if the new or revised part(s) can be shown to conform to the relevant requirements of paragraph 6 or if, in a comparative test, the new part can be shown not to be likely to adversely affect the conformity of the vehicle type.

7.3. The addition by a vehicle manufacturer to an approved vehicle of standard domestic or business equipment, other than mobile communication equipment, which conforms to other regulations, and the installation, substitution or removal of which is according to the recommendations of the equipment and vehicle manufacturers, shall not invalidate the vehicle approval. This shall not preclude vehicle manufacturers fitting communication equipment in accordance with suitable installation guidelines developed by the vehicle manufacturer and/or manufacturer(s) of such communication equipment. The vehicle manufacturer shall provide evidence (if requested by the test authority) that vehicle performance is not adversely affected by such transmitters. This can be a statement that the power levels and installation are such that the immunity levels of this Regulation offer sufficient protection when subject to transmission alone i.e. excluding transmission in conjunction with the tests specified in paragraph 6. This Regulation does not authorize the use of a communication transmitter when other requirements on such equipment or its use apply.

8. CONFORMITY OF PRODUCTION

The conformity of production procedures shall comply with those set out in the Agreement, appendix 2 (E/ECE/324-E/ECE/TRANS/505/Rev.2), with the following requirements:

8.1. Vehicles or components or ESAs approved under this Regulation shall be so manufactured as to conform to the type approved by meeting the requirements set forth in paragraph 6 above.

8.2. Conformity of production of the vehicle or component or separate technical unit shall be checked on the basis of the data contained in the communication form(s) for type approval set out in annex 3A and/or 3B of this Regulation.

8.3. If the competent authority is not satisfied with the checking procedure of the manufacturer, then paragraphs 8.3.1. and 8.3.2. below shall apply.

8.3.1. When the conformity of a vehicle, component or ESA taken from the series is being verified, production shall be deemed to conform to the requirements of this Regulation in relation to broadband electromagnetic disturbances and narrowband electromagnetic disturbances if the levels measured do not exceed by more the 2 dB (25 per cent) the reference limits prescribed in paragraphs 6.2.2.1., 6.2.2.2., 6.3.2.1. and 6.3.2.2. (as appropriate).

8.3.2. When the conformity of a vehicle, component or ESA taken from the series is being verified, production shall be deemed to conform to the requirements of this Regulation in relation to immunity to electromagnetic radiation if the vehicle ESA does not exhibit any degradation relating to the direct control of the vehicle which could be observed by the driver or other road user when the vehicle is in the state defined in annex 6, para. 4, and is subjected to a field strength, expressed in Volts/m, up to 80 per cent of the reference limits prescribed in paragraph 6.4.2.1. above.

9. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

9.1. The approval granted in respect of a type of vehicle, component or separate technical unit pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 6 above are not complied with or if the selected vehicles fail to pass the tests provided for in paragraph 6 above.

9.2. If a Party to the Agreement which applies this Regulation withdraws an approval it has previously granted, it shall forthwith notify the other Contracting Parties applying this Regulation thereof by means of a communication form conforming to the model in annexes 3A and 3B to this Regulation.

10. PRODUCTION DEFINITELY DISCONTINUED

If the holder of an approval permanently ceases to manufacture a type of vehicle or ESA approved in accordance with this Regulation, he shall so inform the authority which granted the approval, which shall in turn notify the other Parties to the 1958 Agreement which apply this Regulation, by means of a communication form conforming to the model in annexes 3A and 3B to this Regulation.

11. MODIFICATION AND EXTENSION OF TYPE APPROVAL OF A VEHICLE OR ESA

11.1. Every modification of the vehicle or ESA type shall be notified to the administrative department which granted approval of the vehicle type. This department may then either:

11.1.1. consider that the modifications made are unlikely to have an appreciable adverse effect and that in any case the vehicle or ESA still meets the requirements; or

11.1.2. require a further test report from the technical service responsible for conducting the tests.

11.2. Notice of conformation of approval or of refusal of approval, accompanied by particulars of the modifications, shall be communicated by the procedure indicated in paragraph 4 above to the Parties to the Agreement applying this Regulation.

11.3. The competent authority granting the approval extension shall assign a serial number to the extension and so notify the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the models in annexes 3A and 3B to this Regulation.

12. TRANSITIONAL PROVISIONS

12.1. As from the official date of entry into force of the 02 series of amendments no Contracting Party applying this Regulation shall refuse to grant approvals under this Regulation as amended by the 02 series of amendments.

12.2. As from 1 January 1998, Contracting Parties applying this Regulation shall grant approvals only if the requirements of this Regulation, as amended by the 02 series of amendments to this Regulation, are satisfied.

12.3. Paragraph 12.2. is not applicable to vehicle types approved to Regulation No. 24 before 1 January 1996 nor, where applicable, to subsequent extensions of these approvals.

12.4. As from 1 October 2002, Contracting Parties applying this Regulation may refuse to recognize approvals which have not been granted in accordance with the 02 series of amendments to this Regulation.

12.5. Notwithstanding the provisions of paragraphs 12.2. and 12.4. above, Contracting Parties applying this Regulation shall continue to grant approvals according to the 01 series of amendments to this Regulation, to components for use on vehicle types which have been approved before the date mentioned in paragraph 12.2. pursuant to either Regulation No. 10 or Regulation No. 24 and, where applicable, subsequent extensions to these approvals.

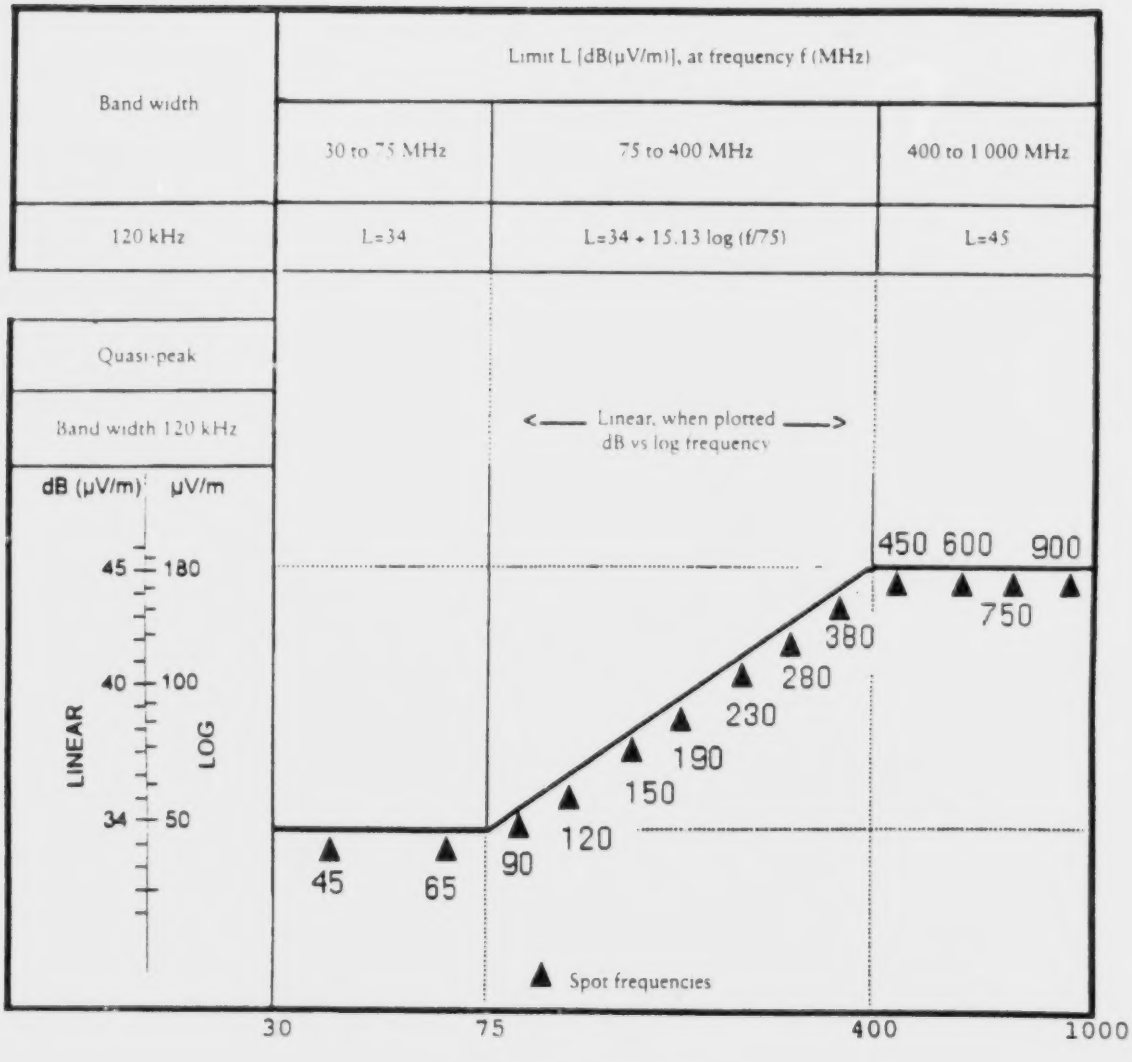
13. NAMES AND ADDRESSES OF TECHNICAL SERVICES CONDUCTING APPROVAL TESTS AND ADMINISTRATIVE DEPARTMENTS

The Parties to the 1958 Agreement applying this Regulation shall communicate to the United Nations Secretariat the names and addresses of the technical services conducting approval tests and of the administrative departments which grant approvals and to which forms certifying approval or extension, refusal or withdrawal of approval, issued in other countries, are to be sent.

Appendix 1

Vehicle broadband reference limits

Antenna-vehicle separation: 10 m

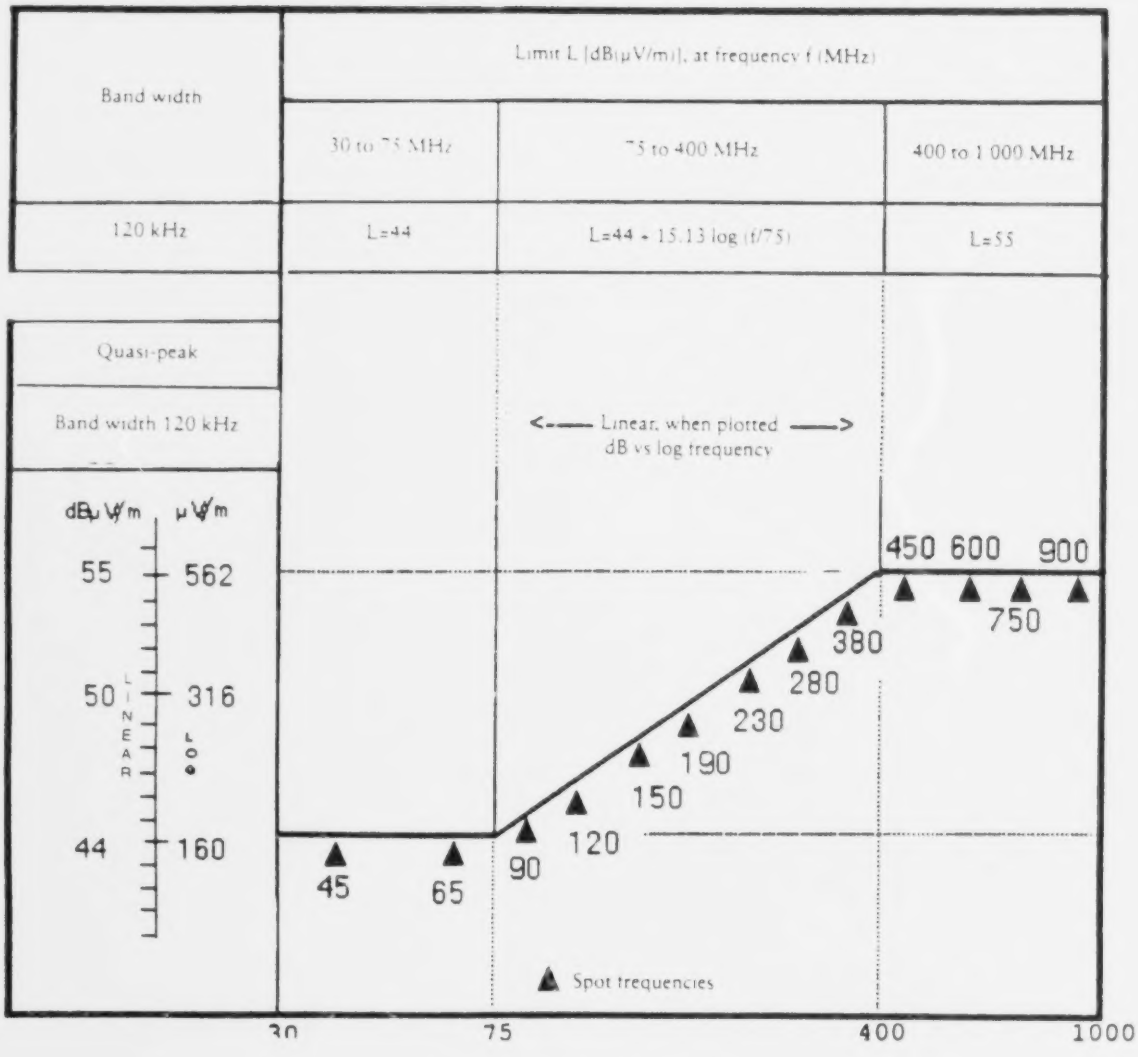


(See paragraph 6.2.2.1.)

Appendix 2

Vehicle broadband reference limits

Antenna-vehicle separation: 3 m

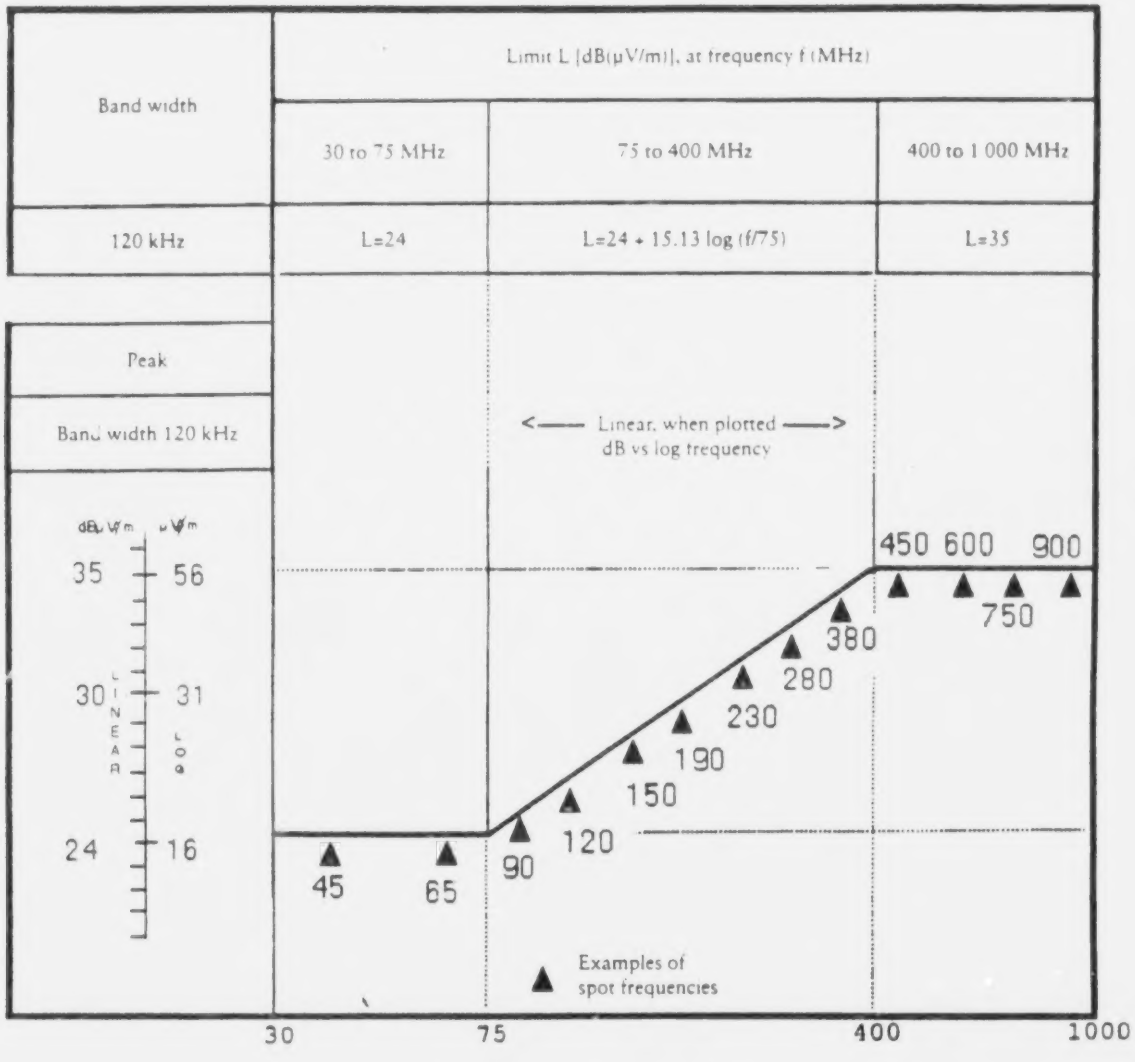


(See paragraph 6.2.2.2.)

Appendix 3

Vehicle narrowband reference limits

Antenna-vehicle separation: 10 m

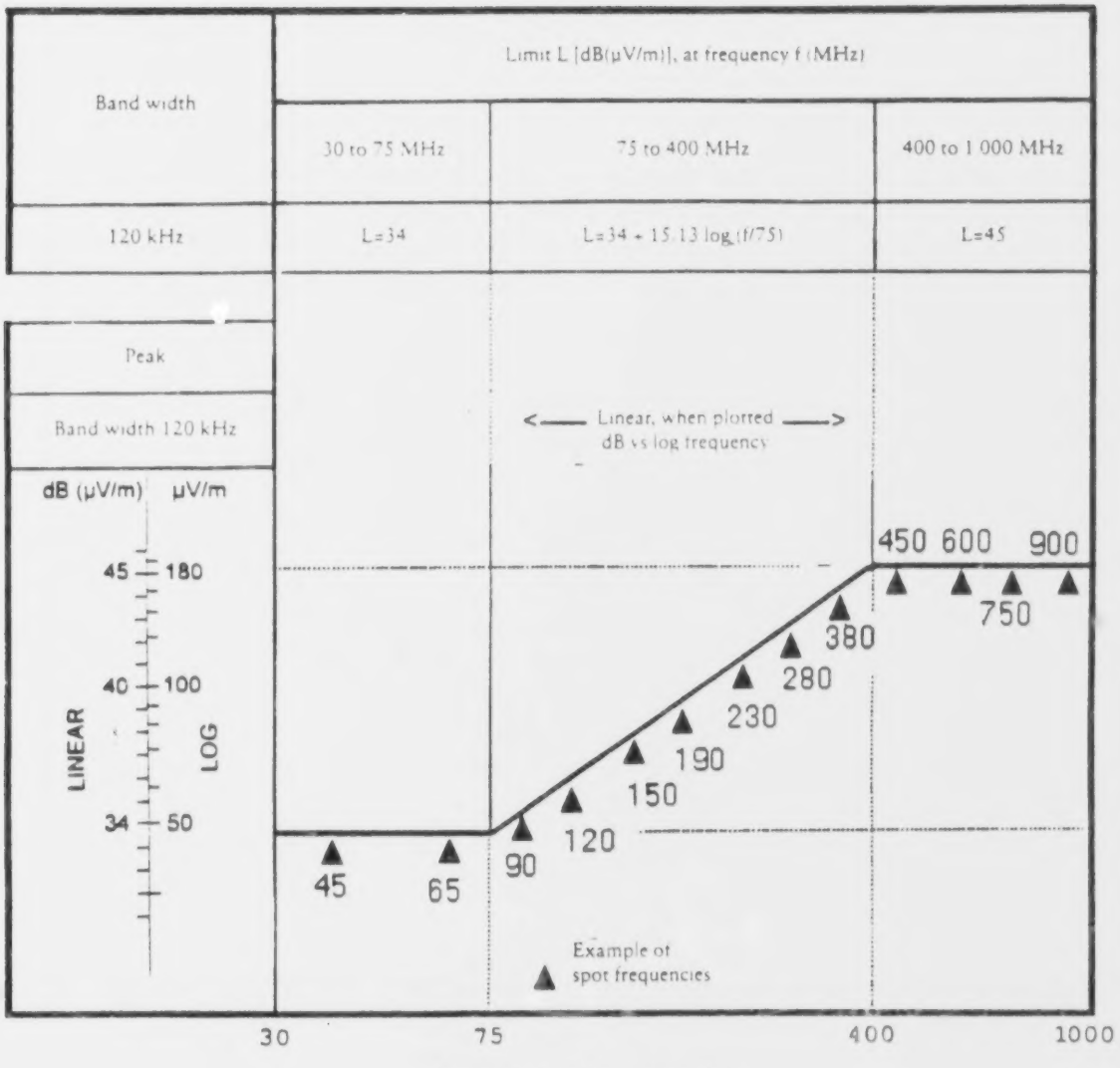


(See paragraph 6.3.2.1.)

Appendix 4

Vehicle narrowband reference limits

Antenna-vehicle separation: 3 m



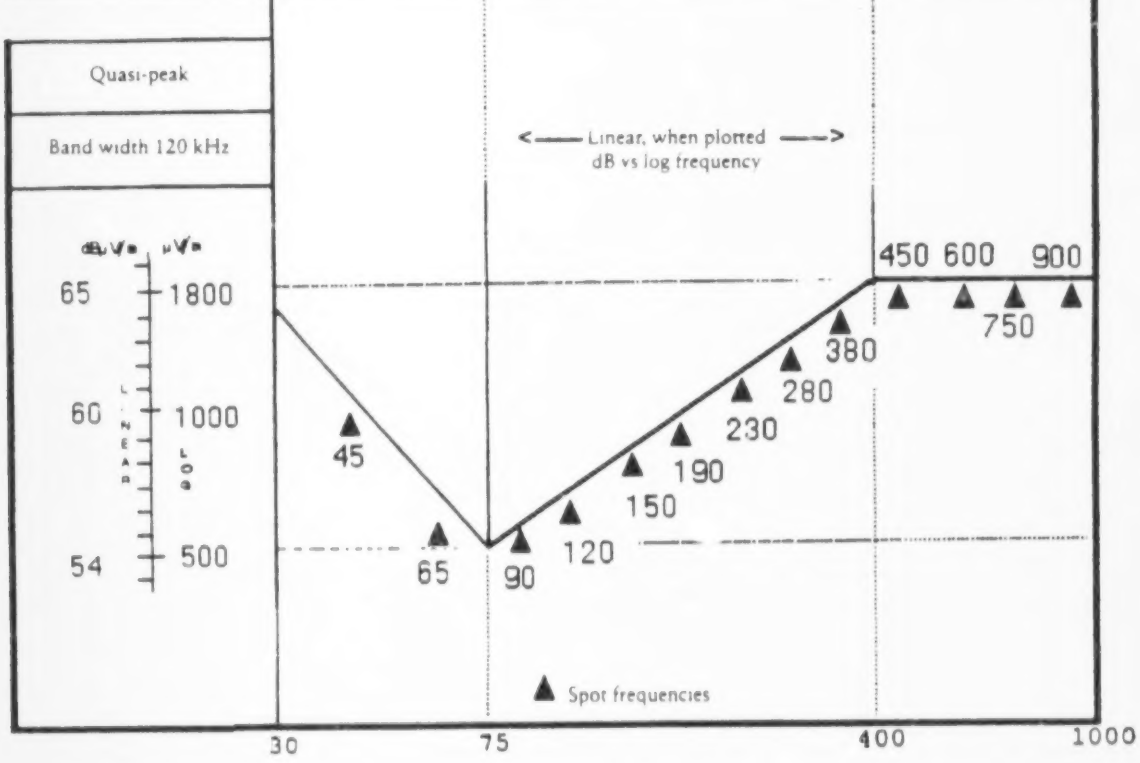
(See paragraph 6.3.2.2.)

Appendix 5

Electrical/electronic sub-assembly

Broadband reference limits

Band width	Limit L [dB(μV/m)], at frequency f (MHz)		
	30 to 75 MHz	75 to 400 MHz	400 to 1 000 MHz
120 kHz	L=64 – 25.13 log (f/30)	L=54 + 15.13 log (f/75)	L=65



Frequency – megahertz – logarithmic

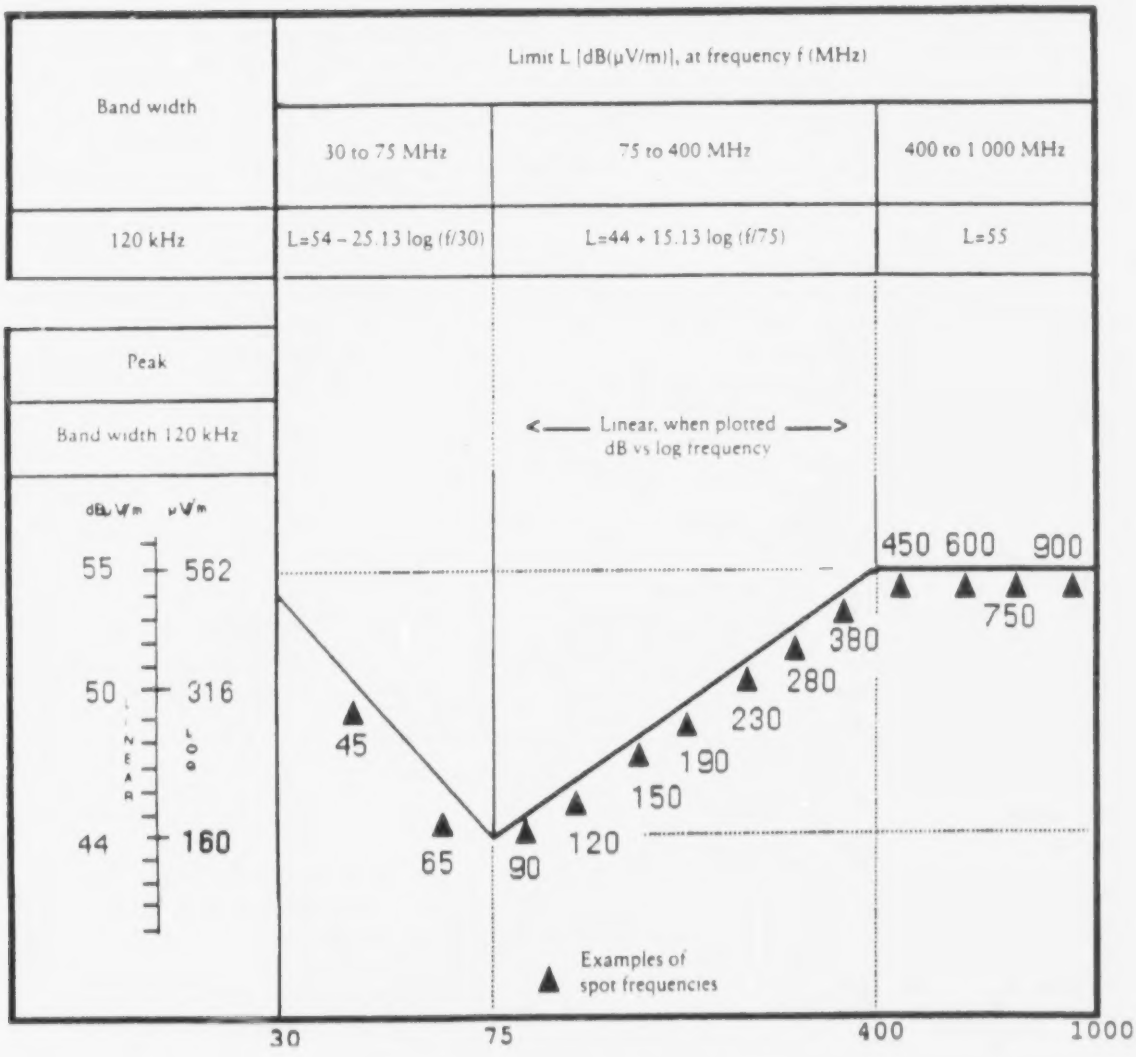
(See paragraph 6.5.2.1.)

Appendix 6

Electrical/electronic sub-assembly

Narrowband reference limits

Band width	Limit L [dB(μV/m)], at frequency f (MHz)		
	30 to 75 MHz	75 to 400 MHz	400 to 1 000 MHz
120 kHz	L=54 – 25.13 log (f/30)	L=44 + 15.13 log (f/75)	L=55



Frequency – megahertz – logarithmic

(See paragraph 6.6.2.1.)

Annex 1

EXAMPLES OF APPROVAL MARKS

Model A

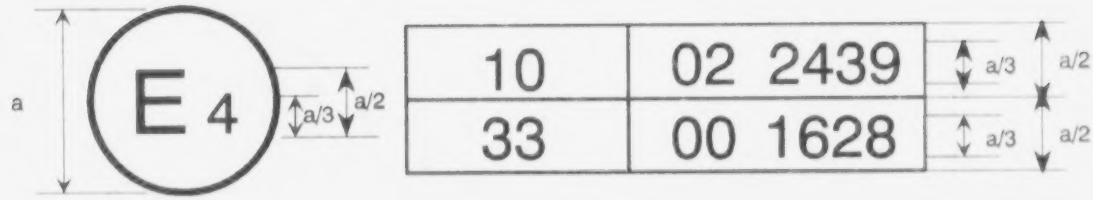
(See paragraph 5.2. of this Regulation)

a = 6 mm min

The above approval mark affixed to a vehicle or ESA shows that the vehicle type concerned has, with regard to electromagnetic compatibility, been approved in the Netherlands (E 4) pursuant to Regulation No. 10 under approval No. 022439. The approval number indicates that the approval was granted according to the requirements of Regulation No. 10 as amended by the 02 series of amendments.

Model B

(See paragraph 5.2. of this Regulation)



a = 6 mm min

The above approval mark affixed to a vehicle or ESA shows that the vehicle type concerned has, with regard to electromagnetic compatibility, been approved in the Netherlands (E 4) pursuant to Regulations Nos. 10 and 33. */ The approval numbers indicate that, at the date when the respective approvals were given, Regulation No. 10 included the 02 series of amendments and Regulation No. 33 was still in its original form.

---

*/ The second number is given merely as an example.

Annex 2A

INFORMATION DOCUMENT

FOR TYPE-APPROVAL OF A VEHICLE WITH RESPECT TO ELECTROMAGNETIC COMPATIBILITY

The following information, if applicable, shall be supplied in triplicate and include a list of contents.

Any drawings shall be supplied in appropriate scale and in sufficient detail on size A4 paper or in a folder of A4 format.

Photographs, if any, shall show sufficient detail.

If the systems, components or separate technical units have electronic controls, information concerning their operation shall be supplied.

GENERAL

1. Make (trade name of manufacturer): . . . . . .

2. Type and general commercial description(s): . . . . . .

3. Means of identification of type, if marked on the vehicle (b): . . . . . .

4. Location of that marking: . . . . . .

5. Category of vehicle (c): . . . . . .

6. Name and address of manufacturer: . . . . . .

7. Address(es) of assembly plant(s): . . . . . .

GENERAL CONSTRUCTION CHARACTERISTICS OF THE VEHICLE

8. Photograph(s) and/or drawing(s) of a representative vehicle: . . . . . .

9. Position and arrangement of the engine: . . . . . .

POWER PLANT (q)

10. Manufacturer: . . . . . .

11. Manufacturer's engine code: . . . . . .
(as marked on the engine, or other means of identification)

12. Working principle: positive ignition/compression ignition, four stroke/two stroke 1/

13. Number and arrangement of cylinders: . . . . . .

14. Maximum net power (t) . . . . . kW at . . . . . rpm

15. Fuel Feed

16. By carburettor(s): yes/no 1/

17. Number fitted: . . . . . .

18. By fuel injection (compression ignition only): yes/no 1/

19. System description: . . . . . .

20. By fuel injection (positive ignition only): yes/no 1/

21. System description: . . . . . .

22. Electrical system

23. Rated voltage: ... V, pos./neg. ground 1/

24. Generator

25. Type: . . . . . .

26. Nominal output: . . . . . VA

27. Ignition

28. Type(s): . . . . . .

29. Working principle: . . . . . .

30. Electric motor

31. Type (winding, excitation): . . . . . .

32. Maximum hourly output: . . . . . kW

TRANSMISSION (v)

33. Type (mechanical, hydraulic, electric, etc.): . . . . . .

34. Brief description of the electrical/electronic components (if any): . . . . . .

SUSPENSION

35. Brief description of the electrical/electronic components (if any): . . . . . .

STEERING

36. Type of steering transmission (specify for front and rear, if applicable): . . . . . .

37. Linkage to wheels (including other than mechanical means; specify for front and rear, if applicable): . . . . . .

38. Brief description of the electrical/electronic components (if any): . . . . . .

39. Range and method of adjustment, if any, of the steering control: . . . . . .

BRAKES

40. For vehicles with anti-lock systems, description of system operation (including any electronic parts), electric block diagram, hydraulic or pneumatic circuit plan: . . . . . .

BODYWORK

41. Type of bodywork: . . . . . .

42. Windscreen and other windows

43. A brief description of the electrical/electronic components (if any) of the window lifting mechanism: . . . . . .

44. Windscreen wiper(s)

45. Detailed technical description (including photographs or drawings): . . . . . .

46. Defrosting and demisting

47. Detailed technical description (including photographs or drawings): . . . . . .

48. Rear-view mirrors (state for each mirror): . . . . . .

49. Brief description of the electronic components (if any) of the adjustment system: . . . . . .

50. Seats

51. Characteristics: Description and drawings of:

52. the adjustment system: . . . . . .

53. the displacement and locking systems: . . . . . .

54. Safety belts and/or other restraint systems

55. Brief description of the electrical/electronic components (if any): . .
. . . . . .

56. Suppression of radio interference

57. Description and drawings/photographs of the shapes and constituent materials of the part of the body forming the engine compartment and the part of the passenger compartment nearest to it: . . . . . .
. . . . . .

58. Drawings or photographs of the position of the metal components housed in the engine compartment (e.g. heating appliances, spare wheel, air filter, steering mechanism, etc.): . . . . . .
. . . . . .

59. Table and drawing of radio interference control equipment: . . . . . .
. . . . . .

60. Particulars of the nominal value of the direct current resistances and, in the case of resistive ignition cables, of their nominal resistance per metre: . . . . . .

LIGHTING AND LIGHT-SIGNALLING DEVICES

61. Brief description of electrical/electronic components other than lamps (if any): . . . . . .

MISCELLANEOUS

62. Devices to prevent unauthorized use of the vehicle

63. Technical description of the device: . . . . . .

64. Brief description of the electrical/electronic components (if any): . .
. . . . . .

Description of vehicle chosen to represent the type

Body style: . . . . . .

Left or right hand drive: . . . . . .

Wheelbase: . . . . . .

Component options: . . . . . .

Relevant test report(s) supplied by the manufacturer or approved/accredited laboratories for the purpose of drawing up the communication form for type-approval.

1/ Strike out what does not apply.

Annex 2B

INFORMATION DOCUMENT

FOR TYPE-APPROVAL OF AN ELECTRIC/ELECTRONIC SUB-ASSEMBLY
WITH RESPECT TO ELECTROMAGNETIC COMPATIBILITY

The following information, if applicable, shall be supplied in triplicate and must include a list of contents.

Any drawings shall be supplied in appropriate scale and in sufficient detail on size A4 paper or in a folder of A4 format.

Photographs, if any, shall show sufficient detail.

If the systems, component or separate technical units have electronic controls, information concerning their performance shall be supplied.

1. Make (trade name of manufacturer): . . . . . .

2. Type and general commercial description(s): . . . . . .

3. Name and address of manufacturer: . . . . . .
. . . . . .

4. In the case of components and separate technical units, location and method of affixing of the approval mark: . . . . . .
. . . . . .

5. Address(es) of assembly plant(s): . . . . . .
. . . . . .

6. This ESA shall be approved as a component/STU 1/

7. Any restrictions of use and conditions for fitting: . . . . . .

Description of the ESA chosen to represent the type:
. . . . . .
. . . . . .
. . . . . .

Relevant test report(s) supplied by the manufacturer or approved/recognized laboratories for the purpose of drawing up the communication form for type-approval.

. . . . . .
. . . . . .
. . . . . .

1/ Strike out what does not apply.

Annex 3A

COMMUNICATION

(maximum format: A4 (210 x 297 mm))

issued by: Name of administration:
.....
.....
.....

concerning: 2/ APPROVAL GRANTED
APPROVAL EXTENDED
APPROVAL REFUSED
APPROVAL WITHDRAWN
PRODUCTION DEFINITELY DISCONTINUED

of a type of vehicle/component/separate technical unit 2/ with regard to Regulation No. 10.

Approval number: ..... Extension No.: .....

1. Make (trade name of manufacturer): . . . . . .

2. Type and general commercial description(s): . . . . . .

3. Means of identification of type, if marked on the vehicle/component/separate technical unit 2/

3.1. Location of that marking: . . . . . .

4. Category of vehicle: . . . . . .

5. Name and address of manufacturer: . . . . . .

6. In the case of components and separate technical units, location and method of affixing of the approval mark: . . . . . .
. . . . . .

1/ Distinguishing number of the country which issued/extended/refused/withdrew approval (see Regulation provisions on approval).

2/ Strike out what does not apply.

7. Address(es) of assembly plant(s): . . . . . .

8. Additional information (where applicable): See appendix

9. Technical service responsible for carrying out the tests: . . . . . .

10. Date of test report: . . . . . .

11. Number of test report: . . . . . .

12. Remarks (if any): See appendix

13. Place: . . . . . .

14. Date: . . . . . .

15. Signature: . . . . . .

16. The index to the information package lodged with the approval authority, which may be obtained on request is attached

* * *

Appendix to type-approval communication form No. .....
concerning the type-approval of a vehicle under
Regulation No. 10

1. Additional information

2. Special devices for the purpose of annex 4 to this Regulation (if applicable) (e.g. .....):

3. Electrical system rated voltage: V. pos/neg ground */

4. Type of bodywork:

5. List of electronic systems installed in the tested vehicle(s) not limited to the items in the information document:

6. Approved/accredited laboratory (for the purpose of this Regulation) responsible for carrying out the tests:

7. Remarks: (e.g. valid for both left-hand drive and right-hand drive vehicles)

---

*/ Strike out what does not apply.

Annex 3B

COMMUNICATION

(maximum format: A4 (210 x 297 mm))

issued by: Name of administration:
.....
.....
.....

concerning: 2/ APPROVAL GRANTED
APPROVAL EXTENDED
APPROVAL REFUSED
APPROVAL WITHDRAWN
PRODUCTION DEFINITELY DISCONTINUED

of a type of electrical/electronic sub-assembly 2/ with regard to Regulation No. 10.

Approval No.:..... Extension No. .....

1. Make (trade name of manufacturer): . . . . . .

2. Type and general commercial description(s): . . . . . .

3. Means of identification of type, if marked on the vehicle/component/separate technical unit: 2/

3.1. Location of that marking: . . . . . .
. . . . . .

4. Category of vehicle: . . . . . .

5. Name and address of manufacturer: . . . . . .
. . . . . .

1/ Distinguishing number of the country which issued/extended/refused/withdrew approval (see Regulation provisions on approval).

2/ Strike out what does not apply.

6. In the case of components and separate technical units, location and method of affixing of the ECE approval mark: . . . . . .

7. Address(es) of assembly plant(s): . . . . . .

8. Additional information (where applicable): See appendix

9. Technical service responsible for carrying out the tests: . . . . . .

10. Date of test report: . . . . . .

11. No. of test report: . . . . . .

12. Remarks (if any): See appendix

13. Place: . . . . . .

14. Date: . . . . . .

15. Signature: . . . . . .

16. The index to the information package lodged with the approval authority, which may be obtained on request, is attached.

* * *

Appendix to type-approval communication form No. .....
concerning the type-approval of an electrical/electronic sub-assembly under Regulation No. 10

1. Additional information

1.1. Electrical system rated voltage: V. pos/neg ground */

1.2. This ESA can be used on any vehicle type with the following restrictions:

1.2.1. Installation conditions, if any:

1.3. This ESA can be used only on the following vehicle types:

1.3.1. Installation conditions, if any:

---

*/ Strike out what does not apply.

1.4. The specific test method(s) used and the frequency ranges covered to determine immunity were: (Please specify precise method used from annex 9)

1.5. Approved/accredited laboratory (for the purpose of this Regulation) responsible for carrying out the test: . . . . . .

2. Remarks: . . . . . .
. . . . . .

Annex 4

METHOD OF MEASURING BROADBAND ELECTROMAGNETIC DISTURBANCES GENERATED BY VEHICLES

1. GENERAL

1.1. The test method described in this annex shall be applied only to vehicles.

1.2. Measuring apparatus

The measuring equipment shall comply with the requirements of Publication No. 16-1 (93) of the International Special Committee on Radio Interference (CISPR).

A Quasi-Peak Detector shall be used for the measurement of broadband electromagnetic disturbances in this annex or, if a peak detector is used, an appropriate correction factor shall be used depending on the spark pulse rate.

1.3. Test method

This test is intended to measure the broadband emissions generated by spark ignition systems.

Two alternative reference antenna distances are permissible: 10 metres or 3 metres from the vehicle. In either case, the requirements of paragraph 3 of this annex shall be complied with.

2. EXPRESSION OF RESULTS

The results of measurements shall be expressed in dB micro-Volt/m (micro-volt/m) for 120 kHz bandwidth. If the actual bandwidth B (expressed in kHz) of the measuring apparatus differs from 120 kHz, the readings taken in micro-Volts/m shall be converted to 120 kHz bandwidth through multiplication by a factor 120/B.

3. MEASURING LOCATION

3.1. The test site shall be a level, clear area free of electromagnetic reflecting surfaces within a circle of minimum radius 30 m measured from a point mid-way between the vehicle and the antenna (see Fig. 1 of appendix 1 to this annex).

3.2. The measuring set, test hut, or vehicle in which the measurement set is located may be within the test site, but only in the permitted area shown in Figure 1 in appendix 1 to this annex.

Other measuring antennae are allowed within the test area, at a minimum distance of 10 m from both the receiving antenna and the

vehicle under test, provided that it can be shown that the test results will not be affected.

3.3. Enclosed test facilities may be used if correlation can be shown between the results obtained in the enclosed test facility and those obtained at an outdoor site. Enclosed test facilities do not need to meet the dimensional requirements of Figure 1 in appendix 1 of this annex other than the distance from the antenna to the vehicle and the height of the antenna. Neither do ambient emissions need to be checked before or after the test as indicated in paragraph 3.4. of this annex.

3.4. Ambient conditions

To ensure that there is no extraneous noise or signal of a magnitude sufficient to affect materially the measurement, measurements shall be taken before and after the main test. If the vehicle is present when ambient measurements are taken, it will be necessary to ensure that any emissions from the vehicle do not affect significantly the ambient measurements, for example by removing the vehicle from the test area, removing the ignition key, or disconnecting the battery. In both of the measurements, the extraneous noise or signal shall be at least 10 dB below the reference limits given in paragraphs 6.2.2.1. or 6.2.2.2. of this Regulation, except for intentional narrowband ambient transmissions.

4. VEHICLE STATE DURING TESTS

4.1. Engine

The engine shall be running at its normal operating temperature and the transmission shall be in neutral. If for practical reasons this cannot be achieved, alternative arrangements mutually agreed between the manufacturer and the test authority may be made. Care shall be taken to ensure that the speed setting mechanism does not influence electromagnetic radiations. During each measurement, the engine shall be operated as follows:

Engine type	Method of measurement	
	Quasi-peak	Peak
Spark ignition	Engine speed	Engine speed
One cylinder	2 500 rpm ± 10%	2 500 rpm ± 10%
More than one cylinder	1 500 rpm ± 10%	1 500 rpm ± 10%

4.2. Testing shall not be conducted while rain or other precipitation is falling on the vehicle or within 10 minutes after such precipitation has stopped.

5. ANTENNA TYPE, POSITION AND ORIENTATION

5.1. Antenna type

Any antenna may be used provided it can be normalized to the reference antenna. The method described in CISPR publication No. 12, Edition 3, appendix A, may be used to calibrate the antenna.

5.2. Height and distance of measurement

5.2.1. Height

5.2.1.1. 10 m test

The phase centre of the antenna shall be 3.00 ± 0.05 m above the plane on which the vehicle rests.

5.2.1.2. 3 m test

The phase centre of the antenna shall be 1.80 ± 0.05 m above the plane on which the vehicle rests.

5.2.1.3. No part of any antenna's receiving elements shall be closer than 0.25 m to the plane on which the vehicle rests.

5.2.2. Distance of measurement

5.2.2.1. 10 m test

The horizontal distance from the tip or other appropriate point of the antenna defined during the normalization procedure described in paragraph 5.1. of this annex to the outer body surface of the vehicle shall be 10.0 ± 0.2m.

5.2.2.2. 3 m test

The horizontal distance from the tip or other appropriate point of the antenna defined during the normalization procedure described in paragraph 5.1. of this annex to the outer body surface of the vehicle shall be 3.00 ± 0.05 m.

5.2.2.3. If the test is carried out in a facility enclosed for radio frequency electromagnetic screening purposes, the antenna's receiving elements shall be no closer than 1.0 m to any radio absorbent material and no closer than 1.5 m to the wall of the enclosed facility. There must be no absorbent material between the receiving antenna and vehicle under test.

5.3. Antenna location relative to vehicle

The antenna shall be located successively on the left-hand and right-hand sides of the vehicle, with the antenna parallel to the plane of longitudinal symmetry of the vehicle and in line with the engine mid-point. (See Fig. 1 in appendix 1 to this annex.)

5.4. Antenna position

At each of the measuring points, readings shall be taken with the antenna in both horizontal and vertical polarizations. (See Fig. 2 in appendix 1 to this annex.)

5.5. Readings

The maximum of the four readings taken in accordance with paragraphs 5.3. and 5.4. at each spot frequency shall be taken as the characteristic reading.

6. FREQUENCIES

6.1. Measurements

Measurements shall be made throughout the 30 to 1,000 MHz frequency range. To confirm that the vehicle meets the requirements of this annex, the testing authority shall test at up to 13 frequencies in the range, e.g.: 45, 65, 90, 120, 150, 190, 230, 280, 380, 450, 600, 750, 900 MHz. In the event that the limit is exceeded during the test, investigations shall be conducted to ensure that this is due to the vehicle and not to background radiation.

6.1.1. The limits shall apply throughout the frequency range 30 MHz - 1,000 MHz.

6.1.2. Measurements can be performed with either quasi-peak or peak detectors. The limits given in paragraphs 6.2. and 6.5. of this Regulation are for quasi-peak. If a peak detector is used, add 38 dB for 1 MHz bandwidth or subtract 22 dB for 1 kHz bandwidth.

6.2. Tolerances

Spot frequency (MHz)	Tolerance (MHz)
45, 65, 90, 120, 150, 190 and 230	± 5
280, 380, 450, 600, 750 and 900	± 20

The tolerances apply to frequencies quoted and are intended to avoid interference from transmissions operating on or near the nominal spot frequencies during the time of measurement.

Annex 4 - Appendix 1

Figure 1

Vehicle test site

Level area free of electromagnatic reflecting surfaces

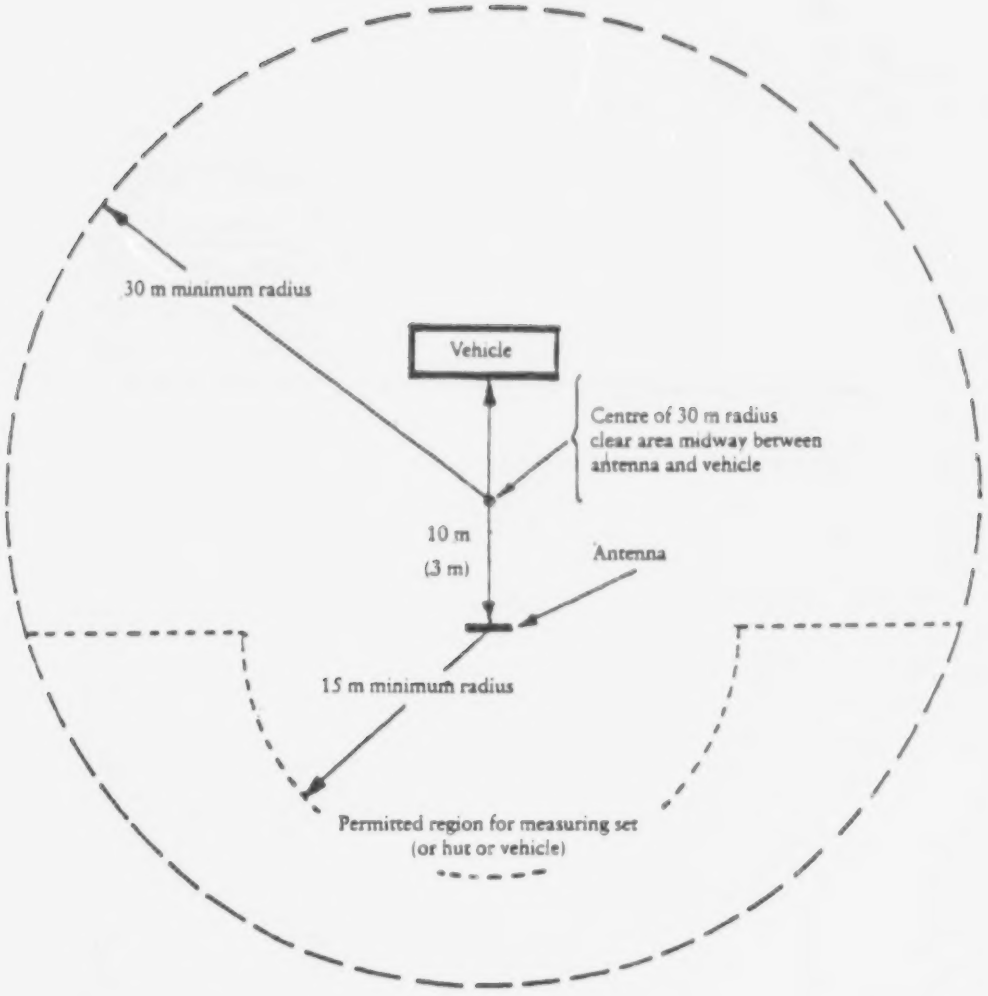
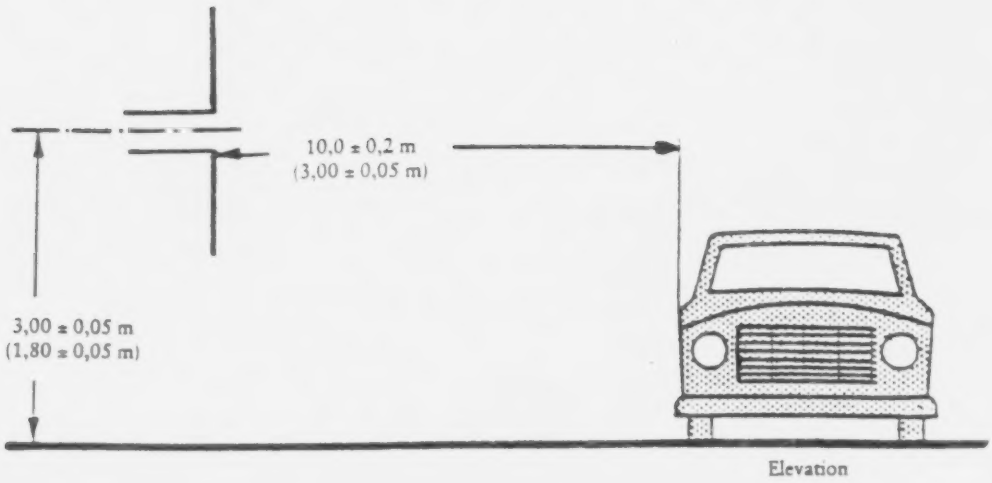
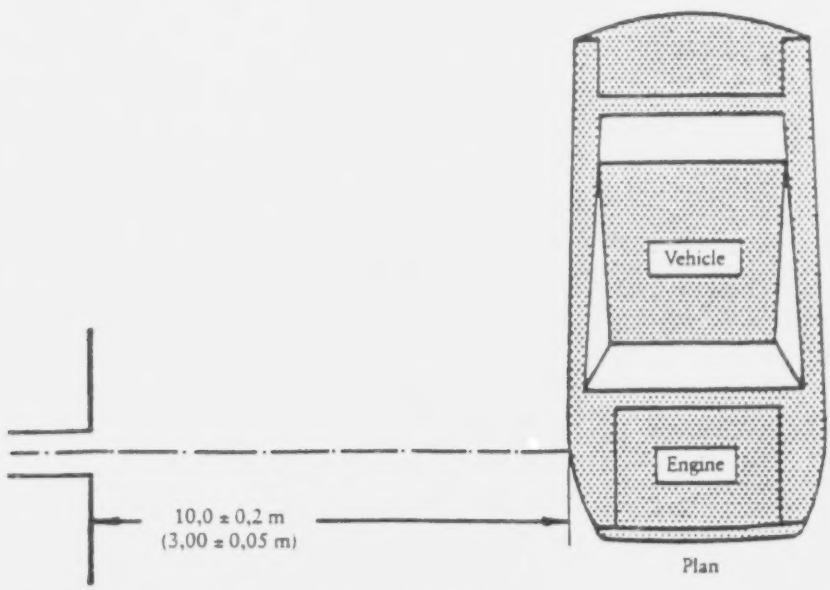


Figure 2

Antenna location relative to vehicle



Dipole antenna in position to measure vertical component of radiation



Dipole antenna in position to measure horizontal component of radiation

Annex 5

METHOD OF MEASURING NARROWBAND ELECTROMAGNETIC DISTURBANCES GENERATED BY VEHICLES

1. GENERAL

1.1. The test method described in this annex shall be applied only to vehicles.

1.2. Measuring apparatus

The measuring equipment shall conform to the requirements of Publication No. 16-1 (93), of the International Special Committee on Radio Interference (CISPR).

An average detector or a peak detector shall be used for measuring the narrowband electromagnetic disturbances covered by this annex.

1.3. Test method

This test is intended to measure narrowband electromagnetic disturbances such as might emanate from a microprocessor-based system or other narrowband source. First, the emission levels in the FM band (88-108 MHz) are measured at the vehicle radio antenna using the apparatus described in paragraph 1.2. If the level specified in paragraph 6.3.2.4. of this Regulation is not exceeded, the vehicle shall be declared to conform to the limit for electromagnetic disturbances prescribed in this annex and the full test need not be carried out.

In the full test procedure, two alternative antenna disturbances are permissible: 10 metres or 3 metres from the vehicle. In either case, the requirements of paragraph 3 of this annex shall be met.

2. EXPRESSION OF RESULTS

The results of measurements shall be expressed in dB micro-Volts/m (micro-Volts/m).

3. MEASURING LOCATION

The test site shall be a level, clear area free of electromagnetic reflecting surfaces within a circle of minimum radius 30 m measured from a point midway between the vehicle and the antenna (see Fig. 1 of appendix 1 to annex 4).

3.1. The measuring set, test hut, or vehicle in which the measurement set is located may be within the test site, but only in the permitted area shown in Fig. 1 in appendix 1 to annex 4.

Other measuring antennae may be allowed within the test area, at a minimum distance of 10 m from both the receiving antenna and the vehicle under test, provided that it can be shown that the test results will not be affected.

3.2. Enclosed test facilities may be used if a correlation can be shown between the results obtained in the enclosed test facility and those obtained at an outdoor site. Enclosed test facilities do not need to meet the dimensional requirements of Fig. 1 in appendix 1 of annex 4, other than the distance from the antenna to the vehicle and the height of the antenna. Neither do ambient emissions need to be checked before or after the test, as indicated in paragraph 3.3. of this annex.

3.3. Ambient conditions

To ensure that there is no extraneous noise or signal of a magnitude sufficient to materially affect the measurement, measurements of ambient conditions shall be taken before and after the main test. When ambient measurements are taken, it will be necessary to ensure that any emissions from the vehicle do not affect significantly the ambient measurements, for example by removing the vehicle from the test area, removing the ignition key, or disconnecting the battery. In both of the measurements, the extraneous noise or signal shall be at least 10 dB below the reference limits given in paragraphs 6.3.2.1. or 6.3.2.2. of this Regulation, except for intentional narrowband ambient transmissions.

4. VEHICLE STATE DURING TESTS

4.1. All the vehicle's electronic systems shall be in normal operating mode, with the vehicle stationary.

4.2. The ignition shall be switched on. The engine must not be running.

4.3. Testing shall not be conducted while rain or other precipitation is falling on the vehicle or within 10 minutes after such precipitation has stopped.

5. ANTENNA TYPE, POSITION AND ORIENTATION

5.1. Antenna type

Any antenna may be used provided it can be normalized to the reference antenna. The method described in CISPR publication No. 12, Edition 3, appendix A, may be used to calibrate the antenna.

5.2. Height and distance of measurement

5.2.1. Height

5.2.1.1. 10 m test

The phase centre of the antenna shall be 3.00 ± 0.05 m above the plane on which the vehicle rests.

5.2.1.2. 3 m test

The phase centre of the antenna shall be 1.80 ± 0.05 m above the plane on which the vehicle rests.

5.2.1.3. No part of any antenna's receiving elements shall be closer than 0.25 m to the plane on which the vehicle rests.

5.2.2. Distance of measurement

5.2.2.1. 10 m test

The horizontal distance from the tip or other appropriate point of the antenna defined during the normalization procedure described in paragraph 5.1. of this annex to the outer body surface of the vehicle shall be 10.0 ± 0.2 m.

5.2.2.2. 3 m test

The horizontal distance from the tip or other appropriate point of the antenna defined during the normalization procedure described in paragraph 5.1. of this annex to the outer body surface of the vehicle shall be 3.00 ± 0.05 m.

5.2.2.3. If the test is carried out in a facility enclosed for radio frequency electromagnetic screening purposes, the antenna's receiving elements shall be no closer than 1.0 m to any radio absorbent material and no closer than 1.5 m to the wall of the enclosed facility. There must be no absorbent material between receiving antenna and vehicle under test.

5.3. Antenna location relative to vehicle

The antenna shall be located successively on the left-hand and right-hand sides of the vehicle, with the antenna parallel to the plane of longitudinal symmetry of the vehicle and in line with the engine mid-point. (See Fig. 2 in appendix 1 to annex 4.)

5.4. Antenna position

At each of the measuring points, readings shall be taken with the antenna in both horizontal and vertical polarizations. (See Fig. 2 in appendix 1 to annex 4.)

5.5. Readings

The maximum of the four readings taken in accordance with paragraphs 5.3. and 5.4. at each spot frequency shall be taken as the characteristic reading.

6. FREQUENCIES

6.1. Measurements

Measurements shall be made throughout the 30 to 1,000 MHz frequency range. This range shall be divided into 13 bands. In each band one spot frequency may be tested to demonstrate that the required limits are satisfied. To confirm that the vehicle meets the requirements of this annex, the testing authority shall test at one such point in each of the following 13 frequency bands: 30-50, 50-75, 75-100, 100-130, 130-165, 165-200, 200-250, 250-320, 320-400, 400-520, 520-660, 660-820, 820-1,000 MHz.

In the event that the limit is exceeded during the test, investigations shall be made to ensure that this is due to the vehicle and not to background radiation.

Annex 6

METHOD OF TESTING IMMUNITY TO ELECTROMAGNETIC RADIATION

1. GENERAL

1.1. The test method described in this annex shall be applied only to vehicles.

1.2. Test method

This test is intended to demonstrate the immunity to degradation in the direct control of the vehicle. The vehicle shall be subjected to electromagnetic fields as described in this annex. The vehicle shall be monitored during the tests.

2. EXPRESSION OF RESULTS

For the test described in this annex, field strengths shall be expressed in Volts/m.

3. MEASURING LOCATION

The test facility shall be capable of generating electromagnetic field strengths over the frequency ranges defined in this annex. The test facility shall conform to national legal requirements regarding the emission of electromagnetic signals.

Care shall be taken so that the control and monitoring equipment shall not be affected by radiated fields in such a way as to invalidate the tests.

4. VEHICLE STATE DURING TESTS

4.1. The vehicle shall be in an unladen condition except for necessary test equipment.

4.1.1. The engine shall normally turn the driving wheels at a steady speed of 50 km/h if there is no technical reason for a manufacturer to prefer a different speed. The vehicle shall be on an appropriately loaded dynamometer or alternatively supported on insulated axle stands with minimum ground clearance if no dynamometer is available. Where appropriate, transmission shafts may be disconnected (e.g. trucks).

4.1.2. Headlamps shall be on dipped beam.

4.1.3. Left or right direction indicator shall be operating.

4.1.4. All other systems which affect the driver's control of the vehicle shall be on as in normal operation of the vehicle.

4.1.5. The vehicle shall not be electrically connected to the test area and no connections shall be made to the vehicle from any equipment, except as required by paragraphs 4.1.1. or 4.2. Tyre contact with the test area floor shall not be considered to be an electrical connection.

4.2. If there are electrical/electronic systems forming an integral part of the direct control of the vehicle, which will not operate under the conditions described in paragraph 4.1., it shall be permissible for the manufacturer to provide a report or additional evidence to the testing authority that the vehicle electrical/electronic systems meet the requirements of this Regulation. Such evidence shall be attached to the type approval documentation.

4.3. Only non-perturbing equipment shall be used while monitoring the vehicle. The vehicle exterior and the passenger compartment shall be monitored to determine whether the requirements of this annex are met (e.g. by using (a) video camera(s)).

4.4. The vehicle shall normally face a fixed antenna. However, where the electronic control units and the associated wiring harness are predominantly in the rear of the vehicle, the test should normally be carried out with the vehicle facing away from the antenna. In the case of long vehicles (i.e. excluding cars and light vans), which have electronic control units and associated wiring harness predominantly towards the middle of the vehicle, a reference point (see para. 5.4. of this annex) shall be established based on either the right side surface or the left side surface of the vehicle. This reference point shall be at the midpoint of the vehicle's longitudinal axis or at a point along the side of the vehicle chosen by the manufacturer in conjunction with the competent authority after considering the distribution of electronic systems and the layout of any wiring harness.

Such testing may take place only if the geometric dimensions of the chamber permit. The antenna location must be noted in the test report.

5. FIELD GENERATING DEVICE TYPE, POSITION AND ORIENTATION

5.1. Field generating device type

5.1.1. The field generating device type(s) shall be chosen so that the desired field strength is achieved at the reference point (see paragraph 5.4. of this annex) at the appropriate frequencies.

5.1.2. The field generating device(s) may be one or more antenna(s) or a transmission line system (TLS).

5.1.3. The construction and orientation of any field generating device shall be such that the generated field is polarized: from 20 to 1,000 MHz horizontally or vertically.

5.2. Height and distance of measurement

5.2.1. Height

5.2.1.1. The phase centre of any antenna shall not be less than 1.5 m above the plane on which the vehicle rests or not less than 2.0 m above the plane on which the vehicle rests if the vehicle roof exceeds 3 m in height.

5.2.1.2. No part of any antenna's radiating elements shall be closer than 0.25 m to the plane on which the vehicle rests.

5.2.2. Distance of measurement

5.2.2.1. In-service conditions may be best approximated by placing the field generating device as far from the vehicle as practical. This distance will typically lie within the range 1 to 5 m.

5.2.2.2. If the test is carried out in an enclosed facility, the field generating device's radiating elements shall be no closer than 1.0 m to any radio absorbent material and no closer than 1.5 m to the wall of the enclosed facility. There shall be no absorbent material between the transmitting antenna and the vehicle under test.

5.3. Antenna location relative to vehicle

5.3.1. The field generating device's radiating elements shall not be closer than 0.5 m to the outer body surface of the vehicle.

5.3.2. The field generating device shall be positioned on the vehicle's centre line (plane of longitudinal symmetry).

5.3.3. No part of a TLS, with the exception of the plane on which the vehicle rests, shall be closer than 0.5 m to any part of the vehicle.

5.3.4. Any field generating device which is placed over the vehicle shall extend centrally over at least 75 per cent of the length of the vehicle.

5.4. Reference point

5.4.1. For the purposes of this annex, the reference point is the point at which the field strength shall be established and shall be defined as follows:

5.4.1.1. at least 2 m horizontally from the antenna phase centre or at least 1 m vertically from the radiating elements of a TLS,

5.4.1.2. on the vehicle's centre line (plane of longitudinal symmetry),

5.4.1.3. at a height of 1.0 ± 0.05 m above the plane on which the vehicle rests or 2.0 ± 0.05 m if the minimum height of the roof of any vehicle in the model range exceeds 3.0 m,

5.4.1.4. either:

1.0 ± 0.2 m inside the vehicle, measured from the point of intersection of the vehicle windscreen and bonnet (point C in appendix 1 to this annex),

or:

0.2 ± 0.2 m from the centre line of the foremost axle of the vehicle measured towards the centre of the vehicle (point D in appendix 2 to this annex),

whichever results in a reference point closer to the antenna.

5.5. If it is decided to radiate the rear of the vehicle, the reference point shall be established as in paragraph 5.4. The vehicle shall then be installed facing away from the antenna and positioned as if it had been horizontally rotated 180 around its centre point, i.e. such that the distance from the antenna to the nearest part of the outer body of the vehicle remains the same. This is illustrated in appendix 3 to this annex.

6. TEST REQUIREMENTS

6.1. Frequency range, dwell times, polarization
The vehicle shall be exposed to electromagnetic radiation in the 20 to 1,000 MHz frequency range.

6.1.1. To confirm that the vehicle meets the requirements of this annex, the vehicle shall be tested at up to 14 spot frequencies in the range, e.g.: 27, 45, 65, 90, 120, 150, 190, 230, 280, 380, 450, 600, 750 and 900 MHz.

The response time of the equipment under test shall be considered and the dwell time shall be sufficient to allow the equipment under test to react under normal conditions. In any case, it shall not be less than 2 seconds.

6.1.2. One mode of polarization shall be used at each frequency - see paragraph 5.1.3.

6.1.3. All other test parameters shall be as defined in this annex.

6.1.4. If a vehicle fails the test defined in paragraph 6.1.1. of this annex, it must be verified as having failed under the relevant test conditions and not as a result of the generation of uncontrolled fields.

7. GENERATION OF REQUIRED FIELD STRENGTH

7.1. Test methodology

7.1.1. The "substitution method" shall be used to obtain the necessary test field strength.

7.1.2. Calibration phase

At each test frequency, a level of power shall be fed into the field generating device to produce the required field strength at the reference point (as defined in paragraph 5) in the test area with the vehicle absent, the level of forward power, or another parameter directly related to the forward power required to define the field, shall be measured and the results recorded. Test frequencies shall lie in the range 20 to 1,000 MHz. Calibration shall be made, starting at 20 MHz, in steps not greater than 2 per cent of the previous frequency, and finishing at 1,000 MHz. These results shall be used for type approval tests unless changes occur in the facilities or equipment which necessitate this procedure being repeated.

7.1.3. Test phase

The vehicle shall then be introduced into the test facility and positioned in accordance with the requirements of paragraph 5. The required forward power defined in paragraph 7.1.2. shall then be applied to the field generating device, in accordance with paragraph 6.1.1.

7.1.4. Whatever parameter is chosen in paragraph 7.1.2. to define the field, the same parameter shall be used to establish the field strength during the test.

7.1.5. The field generating equipment and its layout employed during the test shall be to the same specification as that used during the operations described in paragraph 7.1.2.

7.1.6. Field strength measuring device

A suitable compact field strength measuring device shall be used to determine the field strength during the calibration phase.

7.1.7. During the calibration phase, the phase centre of the field strength measuring device shall be positioned at the reference point.

7.1.8. If a calibrated receiving antenna is used as the field strength measuring device, readings shall be obtained in three mutually orthogonal directions and the isotropic equivalent value of the readings shall be taken as the field strength.

7.1.9. To take account of different vehicle geometries, a number of antennae positions or reference points may need to be established for a given test facility.

7.2. Field strength contour

7.2.1. During the calibration phase (prior to a vehicle being introduced into the test area), the field strength in at least 80 per cent of the calibration frequencies shall be not less than 50 per cent of the nominal field strength, at the following locations:

(i) for all field generating devices, 0.5 ± 0.05 m either side of the reference point on a line passing through the reference point and at the same height as the reference point, and perpendicular to the vehicle plane of longitudinal symmetry;

(ii) in the case of a TLS, 1.50 ± 0.05 m on a line passing through the reference point at the same height as the reference point and along the line of longitudinal symmetry.

7.3. Chamber resonance

Where the conditions described in paragraph 7.2.1. above are not met, tests shall not be performed at chamber resonance frequencies.

7.4. Characteristics of the test signal to be generated.

7.4.1. Maximum envelope excursion

The maximum envelope excursion of the test signal shall equal the maximum envelope excursion of an unmodulated sine wave whose r.m.s. value in Volts/m is defined in paragraph 6.4.2. of this Regulation (see appendix 4 of this annex).

7.4.2. Test signal wave form

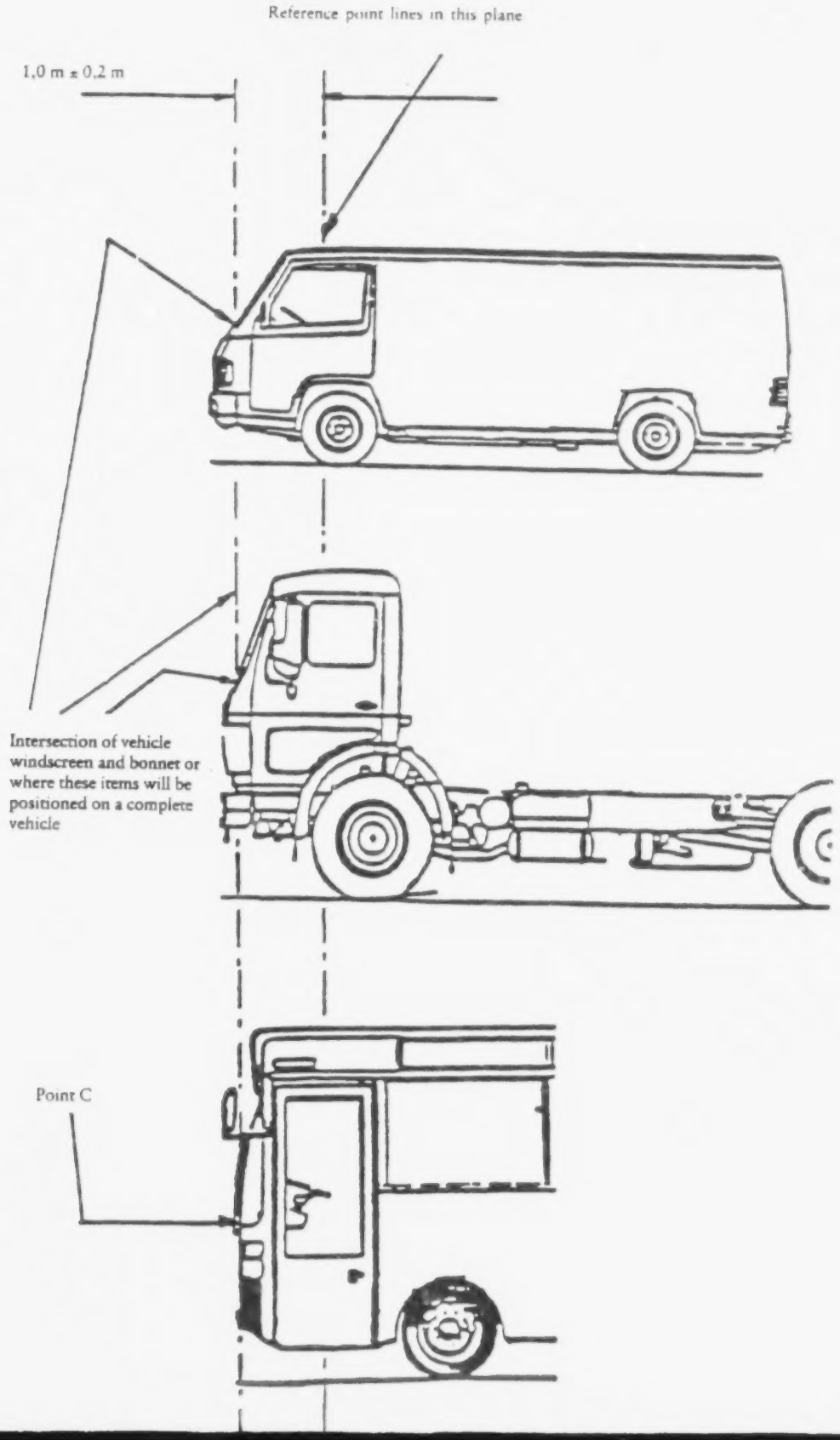
The test signal shall be a radio frequency sine wave, amplitude modulated by a 1 kHz sine wave at a modulation depth m of 0.8 ± 0.04.

7.4.3. Modulation depth

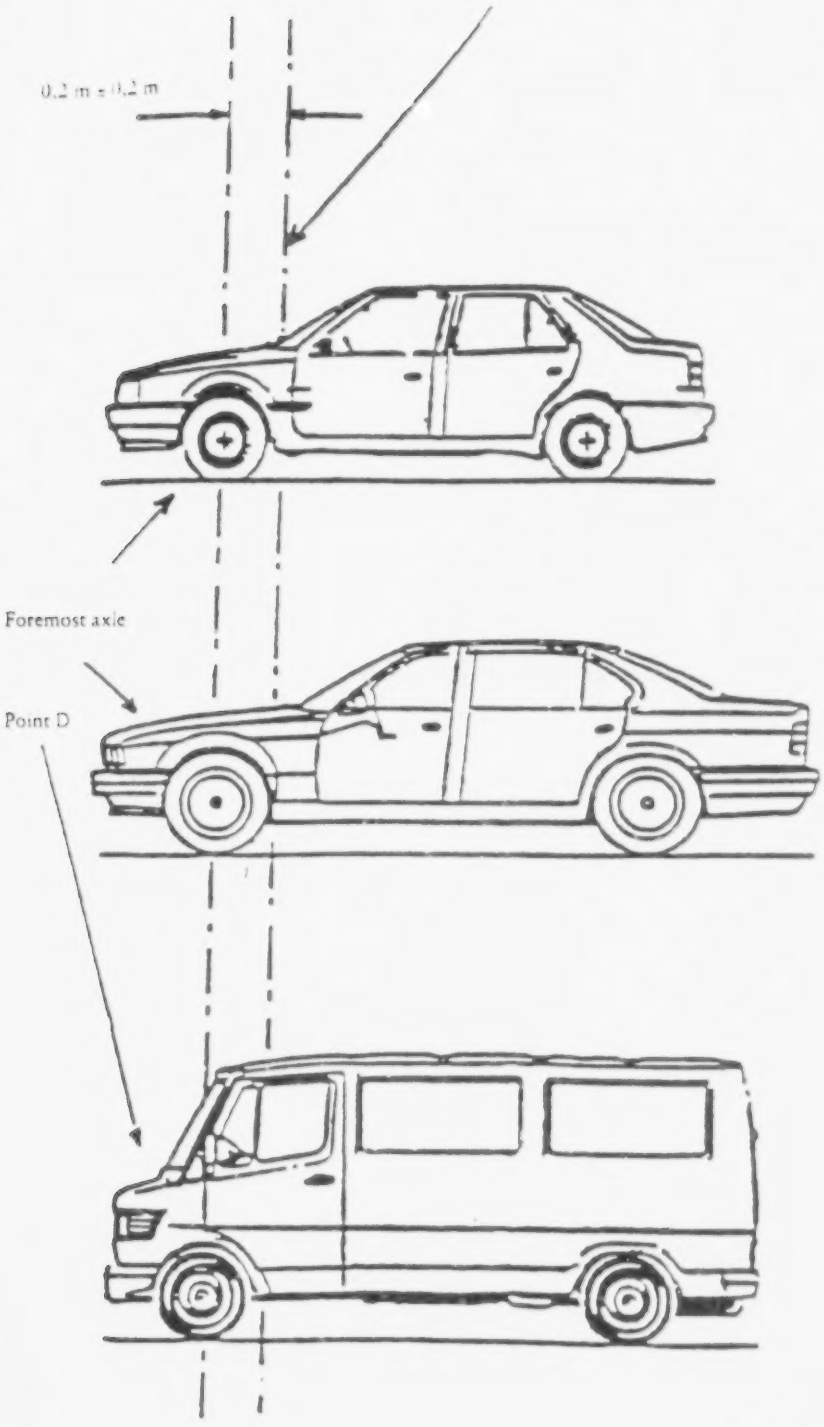
The modulation depth m is defined as:

$$m = \frac{\text{Maximum Envelope Excursion} - \text{Minimum Envelope Excursion}}{\text{Maximum Envelope Excursion} + \text{Minimum Envelope Excursion}}$$

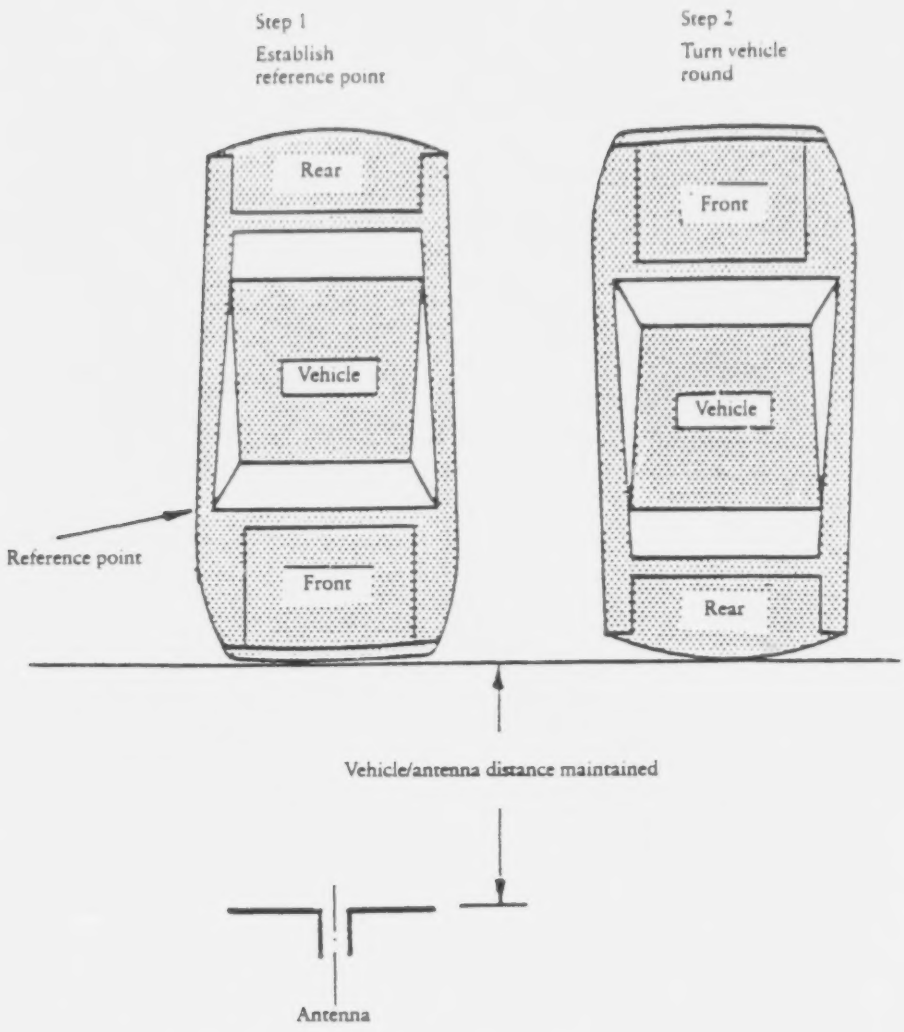
Annex 6 - Appendix 1


Reference point lines in this plane
1,0 m ± 0,2 m
Intersection of vehicle windscreen and bonnet or where these items will be positioned on a complete vehicle
Point C

Annex 6 - Appendix 2

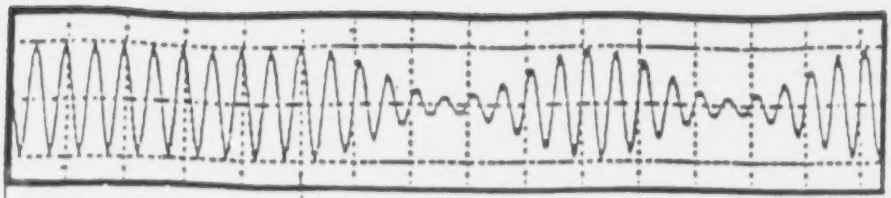


Annex 6 - Appendix 3



Annex 6 - Appendix 4

Characteristics of signal to be generated



Unmodulated sine wave with r.m.s. value as defined in paragraph 6.4.2. of this Regulation	Test signal at 80%, sine wave, amplitude modulated; peak envelope excursion equal to peak excursion of unmodulated sine wave with r.m.s. as defined in paragraph 6.4.2. of this Regulation.

Annex 7

METHOD OF MEASURING BROADBAND ELECTROMAGNETIC DISTURBANCES GENERATED BY ELECTRICAL/ELECTRONIC SUB-ASSEMBLIES

1. GENERAL

1.1. The test method described in this annex shall be applied to ESAs which may be subsequently fitted to vehicles conforming to annex 4.

1.2. Measuring apparatus

The measuring equipment shall conform to the requirements of Publication No. 16-1 (93) of the International Special Committee on Radio Interference (CISPR).

A quasi-peak detector shall be used for the measurement of broadband electromagnetic disturbances covered by this annex or, if a peak detector is used, an appropriate correction factor shall be used depending on the interference pulse rate.

1.3. Test method

This test is intended to measure broadband electromagnetic disturbances generated by ESAs.

2. EXPRESSION OF RESULTS

The results of measurements shall be expressed in dB micro-Volts/m (micro-Volts/m), for 120 kHz bandwidth. If the actual bandwidth B (expressed in kHz) of the measuring apparatus differs from 120 kHz, the readings taken in micro-Volts/m shall be converted to 120 kHz bandwidth through multiplication by a factor of 120/B.

3. MEASURING LOCATION

3.1. The test site shall conform to the requirements of Publication No. 16 of the International Special Committee on Radio Interference (CISPR) (see appendix 1 to this annex).

3.2. The measuring set, test hut or vehicle in which the measurement set is located may be inside the test site, but only in the permitted area shown in appendix 1 to this annex.

3.3. Enclosed test facilities may be used if a correlation can be shown between the results obtained in the enclosed test facility and those obtained at an approved outdoor site. Enclosed test facilities do not need to meet the dimensional requirements of appendix 1 to this annex other than the distance from the antenna to the ESA under test and the height of the antenna, (see Figs. 1 and 2 of appendix 2 to this annex).

3.4. Ambient conditions

To ensure that there is no extraneous noise or signal of a magnitude sufficient to affect materially the measurement, measurements shall be taken before and after the main test. In both of these measurements, the extraneous noise or signal shall be at least 10 dB below the reference limits given in paragraph 6.5.2.1. of this Regulation, except for intentional narrowband ambient transmissions.

4. ESA STATE DURING TESTS

4.1. The ESA under test shall be in normal operation mode.

4.2. Measurements shall not be made while rain or other precipitation is falling on the ESA under test or within 10 minutes after such rain or other precipitation has stopped.

4.3. Test arrangements

4.3.1. The ESA under test and its wiring harness shall be supported 50 ± 5 mm above a wooden or equivalent non-conducting table. However, if any part of the ESA under test is intended to be electrically bonded to a vehicle's metal bodywork, that part shall be placed on a ground plane and shall be electrically bonded to the ground plane. The ground plane shall be a metallic sheet with a minimum thickness of 0.5 mm. The minimum size of the ground plane shall depend on the size of the ESA under test but shall allow for the distribution of the ESA's wiring harness and components. The ground plane shall be connected to the protective conductor of the earthing system. The ground plane shall be situated at a height of 1.0 ± 0.1 m above the test facility floor and shall be parallel to it.

4.3.2. The ESA under test shall be arranged and connected according to its requirements. The power supply harness shall be positioned along, and within 100 mm of, the edge of the ground plane/table closest to the antenna.

4.3.3. The ESA under test shall be connected to the grounding system according to the manufacturer's installation specification, no additional grounding connections shall be permitted.

4.3.4. The minimum distance between the ESA under test and all other conductive structures, such as walls of a shielded area (with the exception of the ground plane/table underneath the test object) must be 1.0 m.

4.4. Power shall be applied to the ESA under test via a 5μH/50Ω artificial network (AN) which shall be electrically bonded to the ground plane. The electrical supply voltage shall be maintained

at ± 10 per cent of its nominal system operating voltage. Any ripple voltage shall be less than 1.5 per cent of the nominal system operating voltage measured at the AN monitoring port.

4.5. If the ESA under test consists of more than one unit, the interconnecting cables should ideally be the wiring harness as intended for use in the vehicle. If these are not available, the length between the main unit and the AN shall be 1,500 ± 75 mm.

All cables in the loom should be terminated as realistically as possible and preferably with real loads and actuators.

If extraneous equipment is required for the correct operation of the ESA under test, compensation shall be made for the contribution it makes to the disturbances measured.

5. ANTENNA TYPE, POSITION AND ORIENTATION

5.1. Antenna type

Any linearly polarized antenna may be used provided it can be normalized to the reference antenna.

5.2. Height and distance of measurement

5.2.1. Height

The phase centre of the antenna shall be 50 ± 10 mm above the ground plane.

5.2.2. Measuring distance

The horizontal distance from the phase centre or other suitable point on the antenna, to the edge of the ground plane shall be 1.00 ± 0.05 m. No part of the antenna shall be closer than 0.5 m to the ground plane.

The antenna shall be placed parallel to a plane which is perpendicular to the ground plane and coincident with the edge of the ground plane along which the principal portion of the harness runs.

5.2.3. If the test is carried out in a facility enclosed for radio frequency electromagnetic screening purposes, the antenna's receiving elements shall be no closer than 0.5 m to any radio absorbent material and no closer than 1.5 m to the wall of the enclosed facility. There must be no absorbent material between the receiving antenna and the ESA under test.

5.3. Antenna orientation and polarization

At the measuring point, readings shall be taken with the antenna in both vertical and horizontal polarizations.

5.4. Readings

The maximum of the two readings taken (in accordance with para. 5.3.) at each spot frequency shall be deemed to be the characteristic reading.

6. FREQUENCIES

6.1. Measurements shall be made throughout the 30 MHz to 1,000 MHz frequency range. An ESA is considered as very likely to satisfy the required limits over the whole frequency range if it satisfies them at the following 13 frequencies in the range, e.g.: 45, 65, 90, 120, 150, 190, 230, 280, 380, 450, 600, 750, 900 MHz.

In the event that the limit is exceeded during the test, investigations shall be made to ensure that the disturbance is due to the ESA and not to background radiation.

6.1.1. The limits shall apply throughout the frequency range 30 MHz-1,000 MHz.

6.1.2. Measurements may be performed with either quasi-peak or peak detectors. The limits given in paragraphs 6.2. and 6.5. are for quasi-peak. If peak is used, add 38 dB for 1 MHz bandwidth or subtract 22 dB for 1 kHz bandwidth.

6.2 Tolerances

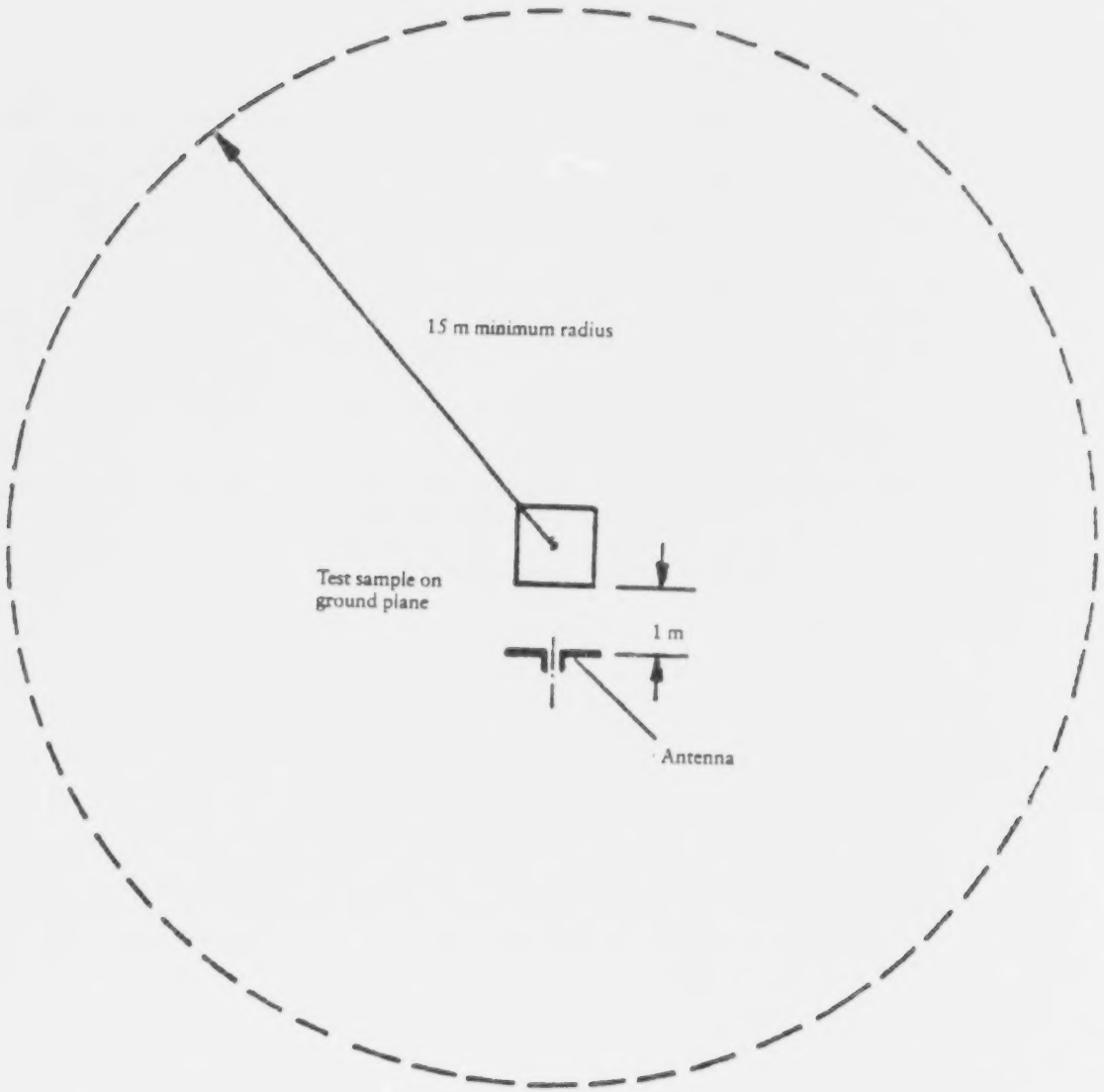
Spot Frequency (MHz)	Tolerance (MHz)
45, 65, 90, 120, 150, 190 and 230	± 5
280, 380, 450, 600, 750 and 900	± 20

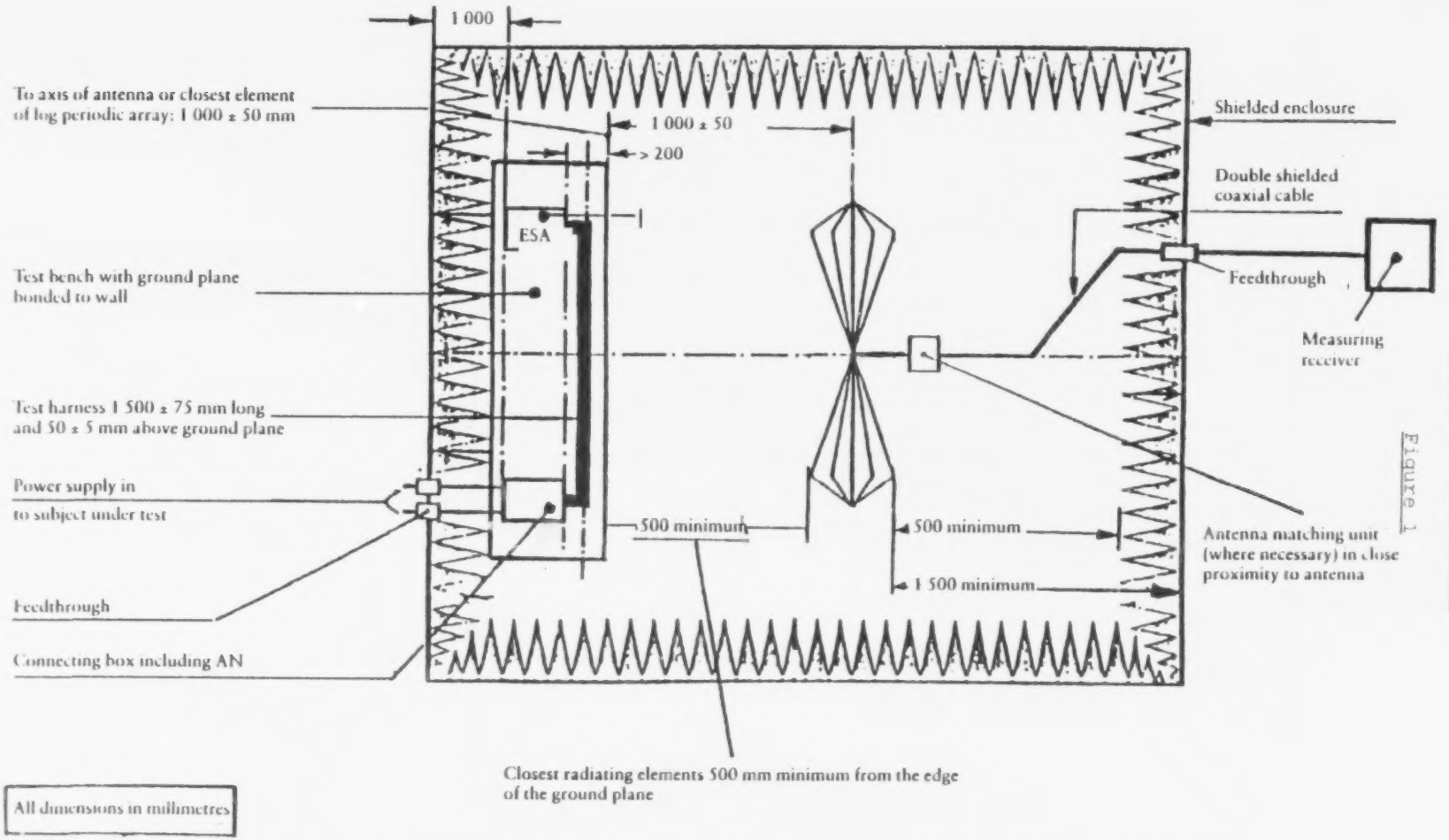
The tolerances apply to frequencies quoted and are intended to avoid interference from transmissions operating on or near the nominal spot frequencies during the time of measurement.

Annex 7 - Appendix 1

Electrical/electronic sub-assembly test site

Level area free of electromagnetic reflecting surfaces




1 000
To axis of antenna or closest element of log periodic array: 1 000 ± 50 mm
1 000 ± 50
> 200
Shielded enclosure
Double shielded coaxial cable
ESA
Test bench with ground plane bonded to wall
Feedthrough
Measuring receiver
Test harness 1 500 ± 75 mm long and 50 ± 5 mm above ground plane
Power supply in
to subject under test
500 minimum
500 minimum
1 500 minimum
Antenna matching unit (where necessary) in close proximity to antenna
Feedthrough
Connecting box including AN
Closest radiating elements 500 mm minimum from the edge of the ground plane
All dimensions in millimetres

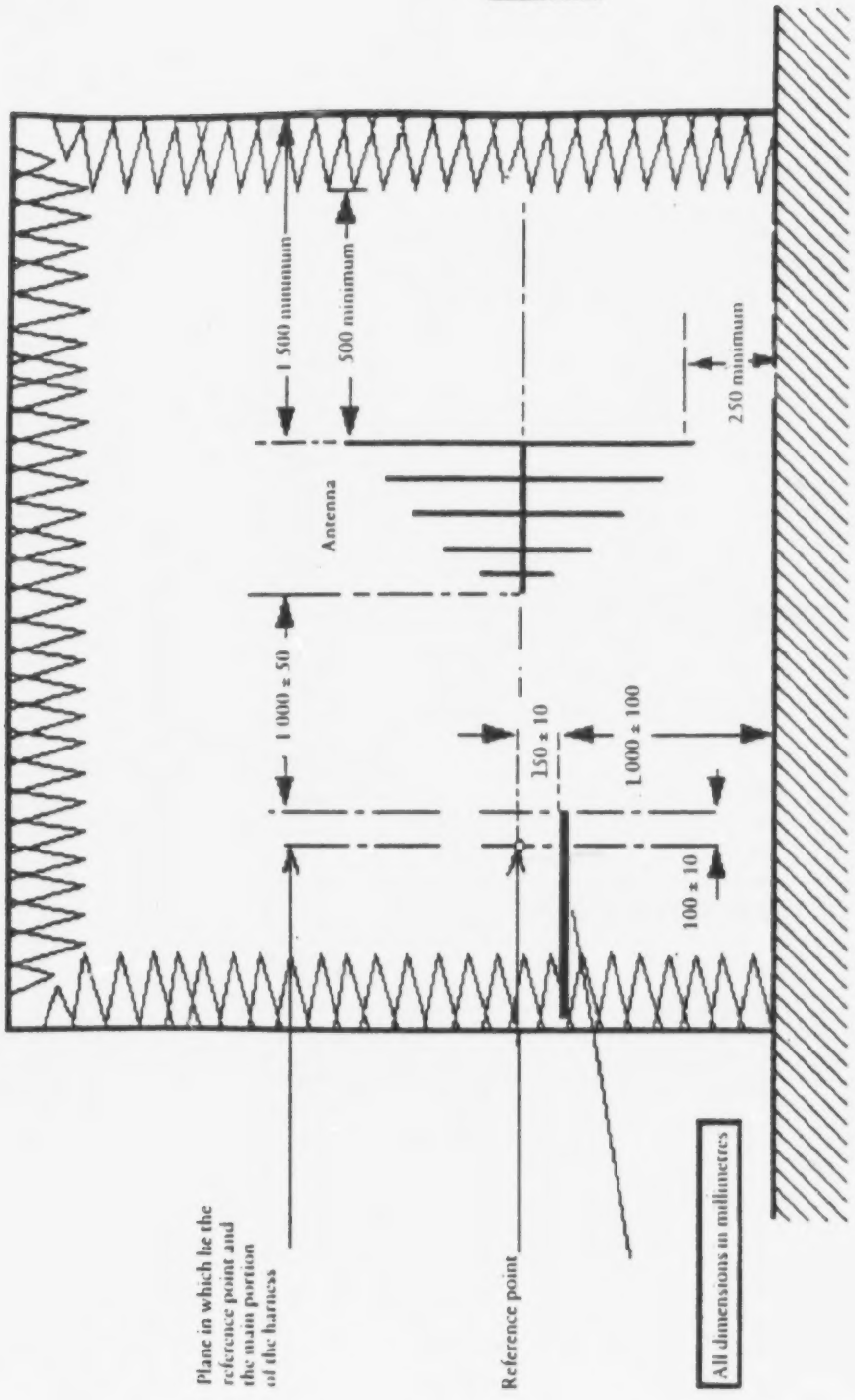
Radiated electromagnetic emissions from an ESA test layout (General plan view)

Annex 7 - Appendix 2

Figure 1

Annex 7 - Appendix 2

Figure 2



Radiated electromagnetic emissions from an ESA view of test bench plane of longitudinal symmetry

Annex 8

METHOD OF MEASURING NARROWBAND ELECTROMAGNETIC DISTURBANCES GENERATED BY ELECTRICAL/ELECTRONIC SUB-ASSEMBLIES

1. GENERAL

1.1. The test method described in this annex shall apply to ESAs.

1.2. Measuring apparatus

The measuring equipment shall conform to the requirements of Publication No. 16-1 (93) of the International Special Committee on Radio Interference (CISPR).

An average detector or a peak detector shall be used for the measurement of narrowband electromagnetic disturbances for the purposes of this annex.

1.3. Test method

This test is intended to measure the narrowband electromagnetic disturbances such as might emanate from a microprocessor-based system.

As a short (2-3 minutes) initial step, choosing one antenna polarization, it is permitted to make sweeps of the frequency range identified in paragraph 6.1. of this annex using a spectrum analyser to indicate the existence and/or whereabouts of peak emissions. This may assist in the choice of frequencies to be tested (see paragraph 6 of this annex).

2. EXPRESSION OF RESULTS

The results of measurements shall be expressed in dB micro-Volts/m (micro-Volts/m).

3. MEASURING LOCATION

3.1. The test site shall conform to the requirements of Publication No. 16-1 (93) of the International Special Committee on Radio Interference (CISPR) (see appendix 1 to annex 7).

3.2. The measuring set, test hut or vehicle in which the measurement set is located shall be outside the boundary shown in appendix 1 to annex 7.

3.3. Enclosed test facilities may be used if correlation can be shown between the results obtained in the enclosed test facility and those obtained in an outdoor site. Enclosed test facilities do not need to meet the dimensional requirements of appendix 1 to annex 7

other than the distance from the antenna to the ESA under test and the height of the antenna (see Figs. 1 and 2 of appendix 2 to annex 7).

3.4. Ambient conditions

To ensure that there is no extraneous noise or signal of a magnitude sufficient to affect materially the measurement, measurements shall be taken before and after the main test. In both of these measurements, the extraneous noise or signal shall be at least 10 dB below the reference limits given in paragraph 6.6.2.1. of this Regulation, except for intentional narrowband ambient transmissions.

4. ESA STATE DURING TESTS

4.1. The ESA under test shall be in normal operation mode.

4.2. Measurements shall not be made while rain or other precipitation is falling on the ESA under test or within 10 minutes after such rain or other precipitation has stopped.

4.3. Test arrangements

4.3.1. The ESA under test and its wiring harness shall be supported 50 ± 5 mm above a wooden or equivalent non-conducting table. However, if any part of the ESA under test is intended to be electrically bonded to a vehicle's metal bodywork, that part shall be placed on a ground plane and shall be electrically bonded to the ground plane.

The ground plane shall be a metallic sheet with a minimum thickness of 0.5 mm. The minimum size of the ground plane depends on the size of the ESA under test but shall allow for the distribution of the ESA's wiring harness and components. The ground plane shall be connected to the protective conductor of the earthing system. The ground plane shall be situated at a height of 1.0 ± 0.1 m above the test facility floor and shall be parallel to it.

4.3.2. The ESA under test shall be arranged and connected according to its requirements. The power supply harness shall be positioned along, and within 100 mm of, the edge of the ground plane/table closest to the antenna.

4.3.3. The ESA under test shall be connected to the grounding system according to the manufacturer's installation specification, no additional grounding connections shall be permitted.

4.3.4. The minimum distance between the ESA under test and all other conductive structures, such as walls of a shielded area (with the

exception of the ground plane/table underneath the test object) must be 1.0 m.

4.4. Power shall be applied to the ESA under test via a 5μH/50Ω resistance artificial network (AN) which shall be electrically bonded to the ground plane. The electrical supply voltage shall be maintained to within ± 10 per cent of its nominal system operating voltage. Any ripple voltage shall be less than 1.5 per cent of the nominal system operating voltage measured at the AN monitoring port.

4.5. If the ESA under test consists of more than one unit, the interconnecting cables should ideally be the wiring harness as intended for use in the vehicle. If these are not available, the length between the electronic control unit and the AN shall be 1,500 ± 75 mm. All cables in the loom should be terminated as realistically as possible and preferably with real loads and actuators. If extraneous equipment is required for the correct operation of the system under test, compensation shall be made for the contribution it makes to the emissions measured.

5. ANTENNA TYPE, POSITION AND ORIENTATION

5.1. Antenna type

Any linearly polarized antenna may be used provided it can be normalized to the reference antenna.

5.2. Height and distance of measurement

5.2.1. Height

The phase centre of the antenna shall be 150 ± 10 mm above the ground plane.

5.2.2. Distance of measurement

The horizontal distance from the phase centre, or tip of the antenna as appropriate, to the edge of the ground plane shall be 1.00 ± 0.05 m. No part of the antenna shall be closer than 0.5 m to the ground plane. The antenna shall be placed parallel to a plane which is perpendicular to the ground plane and coincident with the edge of the ground plane along which the principal portion of the harness runs.

5.2.3. If the test is carried out in a facility enclosed for radio frequency electromagnetic screening purposes, the antenna's receiving elements shall be no closer than 0.5 m to any radio absorbent material and no closer than 1.5 m to the wall of the enclosed facility. There must be no absorbent material between the receiving antenna and the ESA under test.

5.3. Antenna orientation and polarization

At the measuring point, readings shall be taken with the antenna in both vertical and horizontal polarizations.

5.4. Readings

The maximum of the two readings taken (in accordance with paragraph 5.3.) at each spot frequency shall be taken as the characteristic reading.

6. FREQUENCIES

6.1. Measurements

Measurements shall be made throughout the 30 to 1,000 MHz frequency range. This range shall be divided into 13 bands. In each band one spot frequency may be tested to demonstrate that the required limits are satisfied. To confirm that the ESA under test meets the requirements of this annex, the testing authority shall test one such point in each of the following 13 frequency bands: 30-50, 50-75, 75-100, 100-130, 130-165, 165-200, 200-250, 250-320, 320-400, 400-520, 520-660, 660-820, 820-1,000 MHz.

In the event that the reference limit is exceeded during the test, investigations shall be made to ensure that this is due to the ESA under test and not to background radiation.

6.2. If during the initial step which may have been carried out as described in paragraph 1.3. of this annex, the radiated narrowband disturbances for any of the bands identified in paragraph 6.1. are at least 10 dB below the reference limit, then the ESA shall be deemed to conform to the requirements of this annex in respect of that frequency band.

Annex 9

METHOD OF TESTING IMMUNITY OF ELECTRICAL/ELECTRONIC SUB-ASSEMBLIES TO ELECTROMAGNETIC RADIATION

1. GENERAL

1.1. The test methods described in this annex shall be applied to ESAs.

1.2. Test methods

1.2.1. ESAs may conform to the requirements of any combination of the following test methods at the manufacturer's discretion, provided that this results in the full frequency range specified in paragraph 5.1. of this annex being covered.

1.2.1.1. stripline test: See appendix 1 to this annex

1.2.1.2. bulk current injection test: See appendix 2 to this annex

1.2.1.3. TEM cell test: See appendix 3 to this annex

1.2.1.4. free field test: See appendix 4 to this annex

1.2.2. Due to radiation of electromagnetic fields during these tests, all testing shall be conducted in a shielded area.

2. EXPRESSION OF RESULTS

For the tests described in this annex, field strengths shall be expressed in Volts/m and injected current shall be expressed in milliAmps.

3. MEASURING LOCATION

3.1. The test facility shall be capable of generating the required test signals over the frequency ranges defined in this annex. The test facility shall conform to (national) legal requirements regarding the emission of electromagnetic signals.

3.2. The measuring equipment shall be located outside the chamber.

4. STATE OF ESA DURING TESTS

4.1. The ESA under test shall be in normal operation mode. It shall be arranged as defined in this annex unless individual test methods dictate otherwise.

4.2. Power shall be applied to the ESA under test via a (5μH/50Ω) artificial network (AN), which shall be electrically grounded. The electrical supply voltage shall be maintained to within ± 10 per

cent of its nominal system operating voltage. Any ripple voltage shall be less than 1.5 per cent of the nominal system operating voltage measured at the AN monitoring port.

4.3. Any extraneous equipment required to operate the ESA under test shall be in place during the calibration phase. No extraneous equipment shall be closer than 1 m from the reference point during calibration.

4.4. To ensure reproducible measurement results are obtained the test signal generating equipment and its layout shall be to the same specification as that used during each appropriate calibration phase (paras. 7.2., 7.3.2.3., 8.4., 9.2. and 10.2. of this annex).

4.5. If the ESA under test consists of more than one unit, the vehicle wiring harness should preferably be used. If these are not available, the length between the electronic control unit and the AN shall be 1,500 ± 75 mm. All cables in the loom should be terminated as realistically as possible and preferably with real loads and actuators.

5. FREQUENCY RANGE, DWELL TIMES

5.1. Measurements shall be made in the 20 to 1,000 MHz frequency range

5.2. To confirm that the ESAs meet the requirements of this annex, the tests shall be performed at up to 14 spot frequencies in the range, e.g.: 27, 45, 65, 90, 120, 150, 190, 230, 280, 380, 450, 600, 750, 900 MHz.

The response time of the equipment under test shall be considered and the dwell time shall be sufficient to allow the equipment under test to react under normal conditions. In any case, it shall not be less than two seconds.

6. CHARACTERISTICS OF TEST SIGNAL TO BE GENERATED

6.1. Maximum envelope excursion

The maximum envelope excursion of the test signal shall equal the maximum envelope excursion of an unmodulated sine wave whose r.m.s. value is defined in paragraph 6.7.2. of this Regulation (see appendix 4 of annex 6).

6.2. Test signal wave form

The test signal shall be a radio frequency sine wave, amplitude modulated by a 1 kHz sine wave at a modulation depth m of 0.8 ± 0.04.

6.3 Modulation depth

The modulation depth m is defined as:

$$m = \frac{\text{Maximum Envelope Excursion} - \text{Minimum Envelope Excursion}}{\text{Maximum Envelope Excursion} + \text{Minimum Envelope Excursion}}$$

7. STRIPLINE TEST

7.1. Test method

This test method consists of subjecting the wiring harness connecting the components in an ESA to specified field strengths.

7.2. Field strength measurement in the stripline

At each desired test frequency, a level of power shall be fed into the stripline to produce the required field strength in the test area with the ESA under test absent; this level of forward power, or another parameter directly related to the forward power required to define the field, shall be measured and the results recorded.

These results shall be used for type approval tests unless changes occur in the facilities or equipment which necessitate this procedure being repeated.

During this process, the position of the field probe head shall be under the active conductor, centred in longitudinal, vertical and transversal directions. The probe's electronics shall be as far away from the longitudinal stripline axis as possible.

7.3. Installation of the ESA under test

7.3.1. 150 mm stripline test

The test method allows the generation of homogeneous fields between an active conductor (the stripline 50Ω impedance), and a ground plane (the conducting surface of the mounting table), between which part of the wiring harness may be inserted. The electronic controller(s) of the ESA under test shall be installed on the ground plane but outside the stripline with one of its edges parallel to the active conductor of the stripline. It shall be 200 ± 10 mm from a line on the ground plane directly under the edge of the active conductor. The distance between any edge of the active conductor and any peripheral device used for measurement shall be at least 200 mm. The wiring harness section of the ESA under test shall be placed in a horizontal attitude between the active conductor and the ground plane (see Figs. 1 and 2 of appendix 1 to this annex).

7.3.1.1. The minimum length of the wiring harness, which shall include the power harness to the electronic control unit and shall be placed under the stripline, shall be 1.5 m unless the wiring harness in the vehicle is less than 1.5 m. In this case, the length of the wiring harness shall be that of the longest length of harness used in the vehicle. Any line branches occurring in this length shall be routed perpendicularly to the longitudinal axis of the line.

7.3.1.2. Alternatively, the fully extended length of the wiring harness, including the length of the longest of any branches, shall be 1.5 m.

7.3.2. 800 mm stripline test

7.3.2.1. Test method

The stripline consists of two parallel metal plates 800 mm apart. The equipment under test is positioned centrally between the plates and subjected to an electromagnetic field (see Figs. 3 and 4 of appendix 1 to this annex).

This method can be used to test complete electronic systems, including sensors and actuators, as well as the controller and wiring loom. It is suitable for apparatus whose largest dimension is less than 1/3 of the distance between the plates.

7.3.2.2. Positioning of stripline

The stripline shall be housed in a screened room (to prevent external emissions) and positioned 2 m away from walls and any metallic enclosure to prevent electromagnetic reflections. RF absorber material may be used to damp these reflections. The stripline shall be placed on non-conducting supports at least 0.4 m above the floor.

7.3.2.3. Calibration of the stripline

A field measuring probe shall be positioned within the central 1/3 of the space between the plates with the system under test absent. The associated measuring equipment shall be sited outside the screened room.

At each desired test frequency, a level of power shall be fed into the stripline to produce the required field strength at the probe. This level of forward power, or another parameter directly related to the forward power required to define the field, shall be used for type approval tests unless changes occur in the facilities or equipment which necessitate this procedure being repeated.

7.3.2.4. Installation of the ESA under test

The main control unit shall be positioned within the central 1/3 of the space between the plates. It shall be supported on a stand made from non-conducting material.

7.3.2.5. Main wiring loom and sensor/actuator cables

The main wiring loom and any sensor/actuator cables shall rise vertically from the control unit to the top ground plate (this helps to maximize coupling with the electromagnetic field). Then they shall follow the underside of the plate to one of its free edges where they shall loop over and follow the top of the ground plate as far as the connections to the stripline feed. The cables shall then be routed to the associated equipment which shall be sited in an area outside the influence of the electromagnetic field, e.g. on the floor of the screened room not less than 1 m from the stripline.

8. FREE FIELD ESA IMMUNITY TEST

8.1. Test method

This test method allows the testing of vehicle electrical/electronic systems by exposing an ESA to electromagnetic radiation generated by an antenna.

8.2. Test bench description

The test shall be performed on a bench inside a semi-anechoic chamber the anechoic portion of which extends to the bench top.

8.2.1. Ground plane

8.2.1.1. For free field immunity testing, the ESA under test and its wiring harnesses shall be supported 50 ± 5 mm above a wooden or equivalent non-conducting table. However, if any part of the ESA under test is intended to be electrically bonded to a vehicle's metal bodywork, that part shall be placed on a ground plane and shall be electrically bonded to the ground plane. The ground plane shall be a metal sheet with a minimum thickness of 0.5 mm. The minimum size of the ground plane depends on the size of the ESA under test but shall allow for the distribution of the ESA's wiring harness and components. The ground plane shall be connected to the protective conductor of the earthing system. The ground plane shall be situated at a height of 1.0 ± 0.1 m above the test facility floor and shall be parallel to it.

8.2.1.2. The ESA under test shall be arranged and connected according to its requirements. The power supply harness shall be positioned along, and within 100 mm of, the edge of the ground plane/table closest to the antenna.

8.2.1.3. The ESA under test shall be connected to the grounding system according to the manufacturer's installation specification; no additional grounding connections shall be permitted.

8.2.1.4. The minimum distance between the ESA under test and all other conductive structures, such as walls of a shielded area (with the exception of the ground plane/table underneath the test object) must be 1.0 m.

8.2.1.5. The dimension of any ground plane shall be 2.25 m^2 or larger in area with the smaller side no less than 750 mm. The ground plane shall be bonded to the chamber with bonding straps such that the DC bonding resistance shall not exceed 2.5 milliohms.

8.2.2. Installation of ESA under test

For large equipment mounted on a metal test stand, the test stand shall be considered a part of the ground plane for testing purposes and shall be bonded accordingly. The faces of the test sample shall be located at a minimum of 200 mm from the edge of the ground plane. All leads and cables shall be a minimum of 100 mm from the edge of the ground plane and the distance to the ground plane (from the lowest point of the harness) shall be 50 ± 5 mm above the ground plane. Power shall be applied to the ESA under test via a (5µH/50Ω) artificial network (AN).

8.3. Field generating device type, position and orientation

8.3.1. Field generating device type

8.3.1.1. The field generating device type(s) shall be chosen such that the desired field strength is achieved at the reference point (see para. 8.3.4. of this annex) at the appropriate frequencies.

8.3.1.2. The field generating device(s) may be one or more antennas or a plate antenna.

8.3.1.3. The construction and orientation of any field generating device shall be such that the generated field is polarized: from 20 to 1,000 MHz horizontally or vertically.

8.3.2. Height and distance of measurement

8.3.2.1. Height

The phase centre of any antenna shall be 150 ± 10 mm above the ground plane on which the ESA under test rests. No parts of any antenna's radiating elements shall be closer than 250 mm to the floor of the facility.

8.3.2.2. Distance of measurement

8.3.2.2.1. In-service conditions may best be approximated by placing the field generating device as far from the ESA as practical. This distance will typically lie within the range 1 to 5 m.

8.3.2.2.2. If the test is carried out in an enclosed facility, the antenna's radiating elements shall be no closer than 0.5 m to any radio absorbent material and no closer than 1.5 m to the wall of the facility. There shall be no absorbent material interposed between the transmitting antenna and the ESA under test.

8.3.3. Antenna location relative to ESA under test

8.3.3.1. The field generating device's radiating elements shall not be closer than 0.5 m to the edge of the ground plane.

8.3.3.2. The phase centre of the field generating device shall be on a plane which:

(i) is perpendicular to the ground plane;

(ii) bisects the edge of the ground plane and the mid-point of the principal portion of the wiring harness;

and

(iii) is perpendicular to the edge of the ground plane and the principal portion of the wiring harness.

The field generating device shall be placed parallel to this plane (see Figs. 1 and 2 of appendix 4 to this annex).

8.3.3.3. Any field generating device which is placed over the ground plane or ESA under test shall extend over the ESA under test.

8.3.4. Reference point

For the purposes of this annex, the reference point is the point at which the field strength shall be established and shall be defined as follows:

8.3.4.1. At least 1 m horizontally from the antenna phase centre or at least 1 m vertically from the radiating elements of a plate antenna.

8.3.4.2. On a plane which:

(i) is perpendicular to the ground plane;

(ii) is perpendicular to the edge of the ground plane along which the principal portion of the wiring harness runs;

(iii) bisects the edge of the ground plane and the mid-point of the principal portion of the wiring harness;

(iv) coincides with the midpoint of the principal portion of the harness which runs along the edge of the ground plane closest to the antenna.

8.3.4.3. 150 ± 10 mm above the ground plane.

8.4. Generation of required field strength: test methodology

8.4.1. The "substitution method" shall be used to establish the test field strength necessary.

8.4.2. Substitution method: calibration

At each desired test frequency, a level of power shall be fed into the field generating device to produce the required field strength at the reference point (as defined in para. 8.3.4.) in the test area with the ESA under test absent; this level of forward power, or another parameter directly related to the forward power required to define the field, shall be measured and the results recorded. These results shall be used for type approval tests unless changes occur in the facilities or equipment which necessitates this procedure being repeated.

8.4.3. Extraneous equipment must be a minimum of 1 m from the reference point during calibration.

8.4.4. Field strength measuring device

A suitable compact field strength measuring device shall be used to determine the field strength during the calibration phase of the substitution method.

8.4.5. The phase centre of the field strength measuring device shall be positioned at the reference point.

8.4.6. The ESA under test which may include an additional ground plane shall then be introduced into the test facility and positioned in accordance with the requirements of paragraph 8.3. If a second ground plane is used, then it shall be within 5 mm of the bench ground plane and electrically bonded to it. The required forward power defined in paragraph 8.4.2. at each frequency as defined in paragraph 5 shall then be applied to the field generating device.

8.4.7. Whatever parameter was chosen in paragraph 8.4.2. to define the field, the same parameter shall be used to determine the field strength during the test.

8.5. Field strength contour

8.5.1. During the calibration phase of the substitution method (prior to an ESA under test being introduced into the test area), the field strength shall not be less than 50 per cent of the nominal field strength 0.5 ± 0.05 m either side of the reference point on a line parallel to the edge of the ground plane nearest to the antenna and passing through the reference point.

9. TEM CELL TEST

9.1. Test method

The TEM (Transverse Electromagnetic Mode) cell generates homogeneous fields between the internal conductor (septum) and housing (ground plane). It is used for testing ESAs (see Fig. 1 of appendix 3 to this annex).

9.2. Field strength measurement in a TEM cell

9.2.1. The electrical field in the TEM cell shall be determined by using the equation:

$$|E| = \frac{\sqrt{(P.Z)}}{d}$$

E = electric field (Volts/metre)
P = power flowing into cell (W)
Z = impedance of cell (50Ω)
d = separation distance (metres) between the upper wall and the plate (septum).

9.2.2. Alternatively, an appropriate field strength sensor shall be placed in the upper half of the TEM cell. In this part of the TEM cell, the electronic control unit(s) has only a small influence on the test field. The output of this sensor shall determine the field strength.

9.3. Dimensions of TEM cell

In order to maintain a homogeneous field in the TEM cell and to obtain repeatable measurement results, the test object shall not be larger than 1/3 of the cell inside height. Recommended TEM cell dimensions are given in appendix 3, Figures 2 and 3, to this annex.

9.4. Power, signal and control wires

The TEM cell shall be attached to a co-axial socket panel and connected as closely as possible to a plug connector with an adequate number of pins. The supply and signal leads from the plug

connector in the cell wall shall be directly connected to the test object.

The external components such as sensors, power supply and control elements can be connected:

(i) to a screened peripheral;

(ii) to the vehicle next to the TEM cell;

or

(iii) directly to the screened patchboard.

Screened cables must be used in connecting the TEM cell to the peripheral or the vehicle if the vehicle or peripheral is not in the same or adjacent screened room.

10. BULK CURRENT INJECTION TESTING

10.1. Test method

This is a method of carrying out immunity tests by inducing currents directly into a wiring harness using a current injection probe. The injection probe consists of a coupling clamp through which the cables of the ESA under test are passed. Immunity tests can then be carried out by varying the frequency of the induced signals.

The ESA under test may be installed on a ground plane as in paragraph 8.2.1. or in a vehicle in accordance with the vehicle design specification.

10.2. Calibration of bulk current injection probe prior to commencing tests

The injection probe shall be mounted in a calibration jig. Whilst sweeping the test frequency range, the power required to achieve the current specified in paragraph 6.7.2.1. of this Regulation, shall be monitored. This method is used to calibrate the bulk current injection system forward power versus current prior to testing, and it is this forward power which shall be applied to the injection probe when connected to the ESA under test via the cables used during calibration. It should be noted that the monitored power applied to the injection probe is the forward power.

10.3. Installation of the ESA under test

For an ESA mounted on a ground plane as in paragraph 8.2.1., all cables in the wiring harness should be terminated as realistically as possible and preferably with real loads and actuators. For both

vehicle-mounted and ground plane-mounted ESAs, the current injection probe shall be mounted around all the wires in the wiring harness on each connector and 150 ± 10 mm from each connector of the electronic control unit (ECU), instrument modules or active sensors as illustrated in Figure 1 of appendix 2.

10.4. Power, signal and control wires

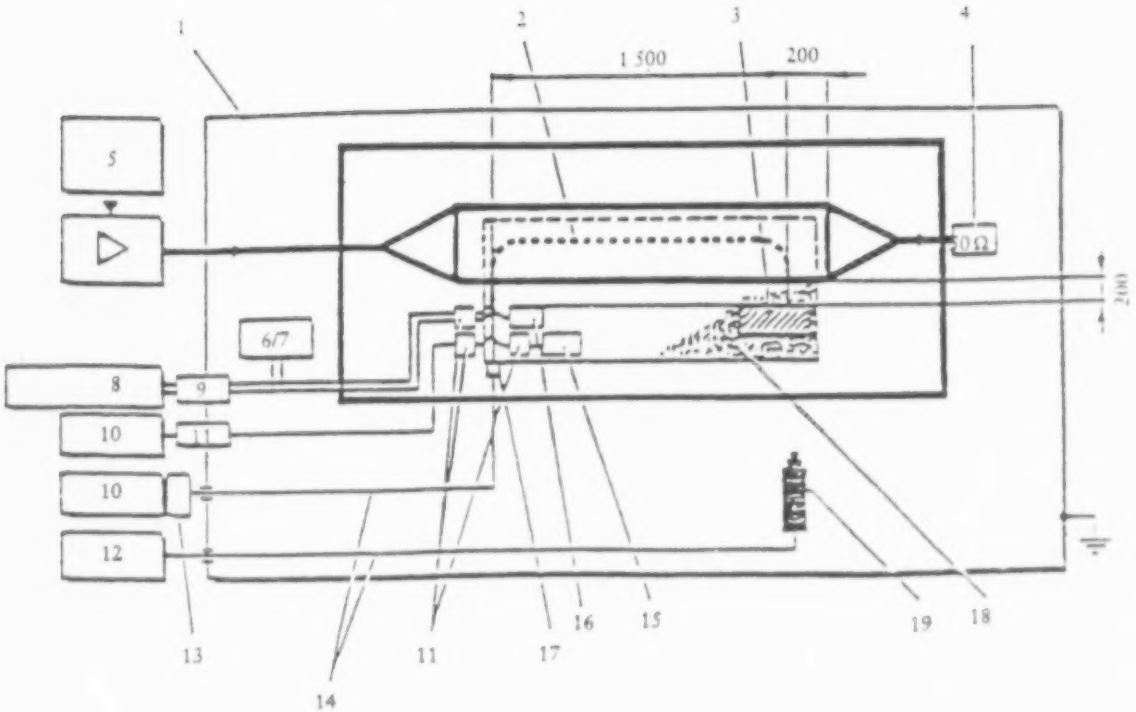
For an ESA under test mounted on a ground plane as in paragraph 8.2.1., a wiring harness shall be connected between an artificial network (AN) and the principal electronic control unit. This harness shall run parallel to the edge of the ground plane and 200 mm minimum from its edge. This harness shall contain the power feed wire which is used to connect the vehicle battery to this ECU and the power return wire if used on the vehicle.

The distance from the ECU to the AN shall be 1.0 ± 0.1 m or shall be the harness length between the ECU and the battery as used on the vehicle, if known, whichever is the shorter. If a vehicle harness is used then any line branches which occur in this length shall be routed along the ground plane but perpendicular away from the edge of the ground plane. Otherwise, the other wires which are in this length shall break out at the AN.

Annex 9 - Appendix 1

Figure 1

150 mm Stripline testing

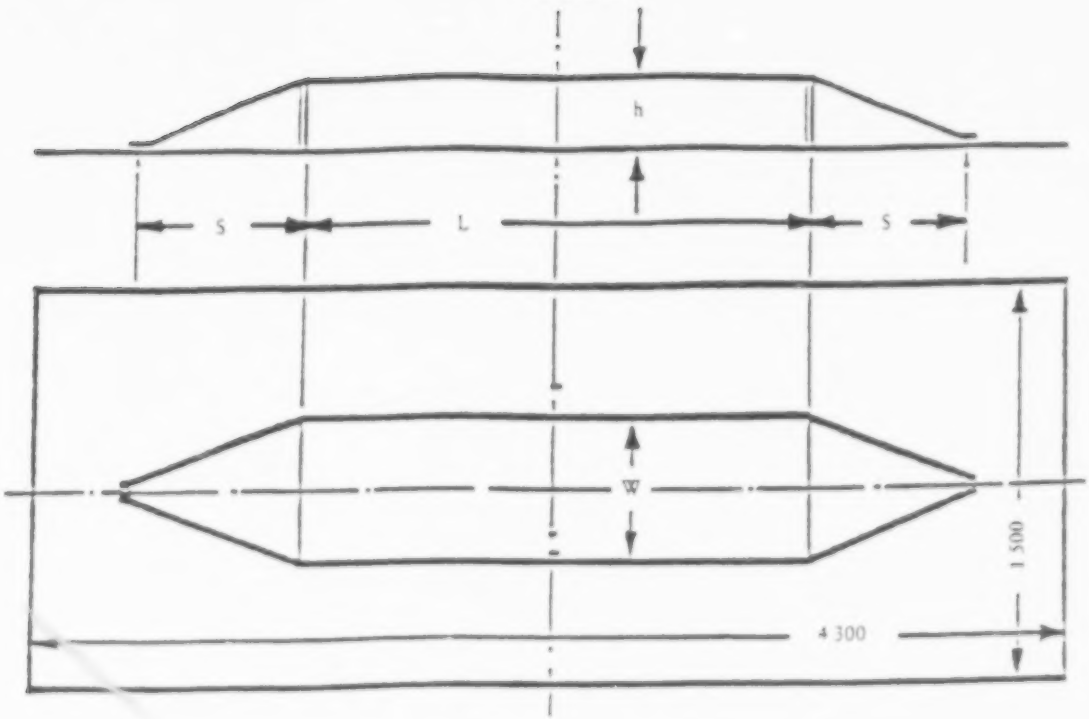


1 = Shielded room
2 = Cable harness
3 = Test object
4 = Terminating resistance
5 = Frequency generator
6/7 = Alternative battery
8 = Power supply
9 = Filter
10 = Peripheral
11 = Filter
12 = Video peripheral
13 = Opto-electrical converter
14 = Optical lines
15 = Non irradiation-proof peripheral
16 = Linear or radiation-proof peripheral
17 = Opto-electrical converter
18 = Insulating base
19 = Video camera

All dimensions in millimetres

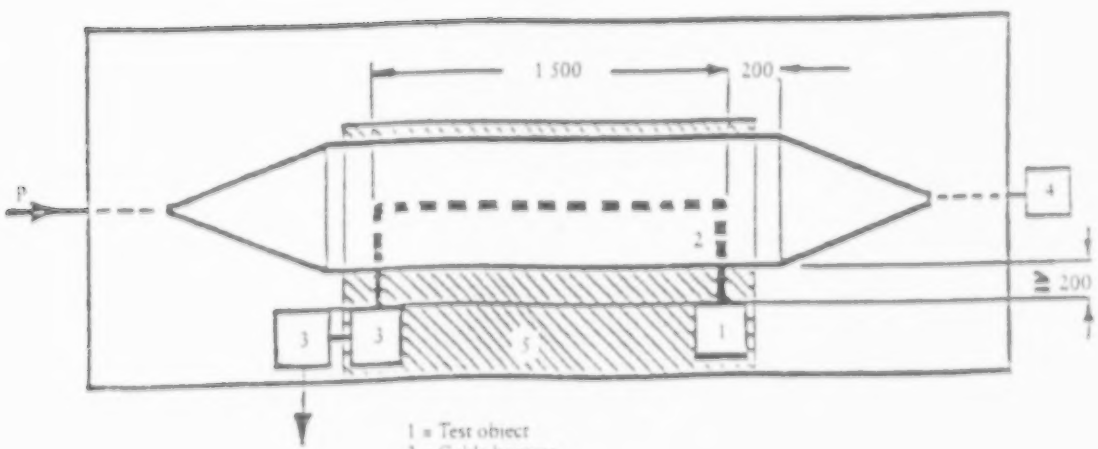
Annex 9 - Appendix 1 (cont'd)

Figure 2



L = 2 500 mm
S = 800 mm
W = 740 mm
h = 150 mm

All dimensions in millimetres



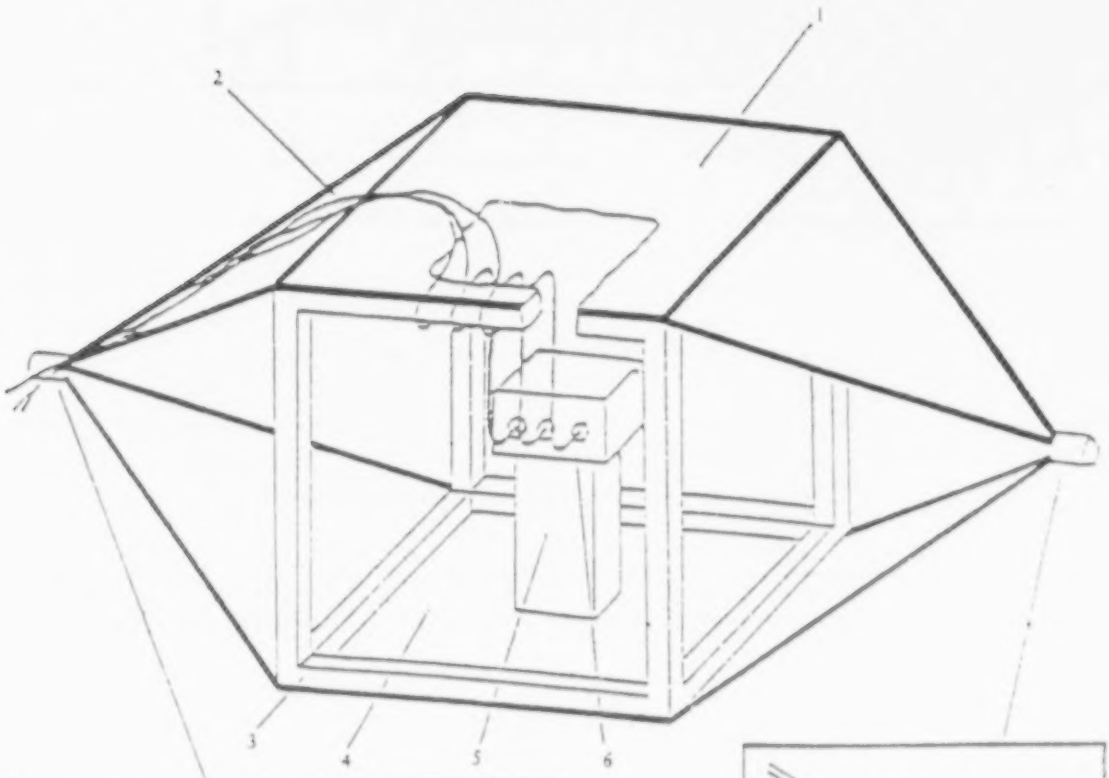
1 = Test object
2 = Cable harness
3 = Peripheral
4 = Terminating resistance
5 = Insulting base

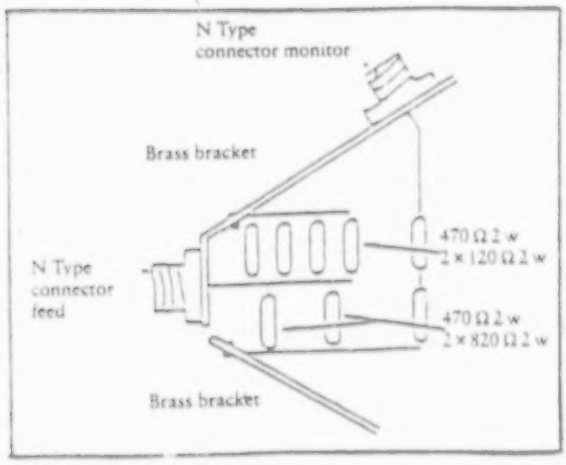
150 mm Stripline testing

Annex 9 - Appendix 1 (cont'd)

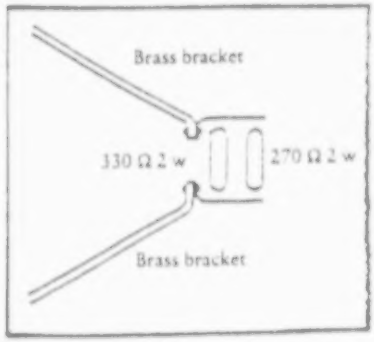
Figure 3

800 mm Stripline testing





Details of stripline feed

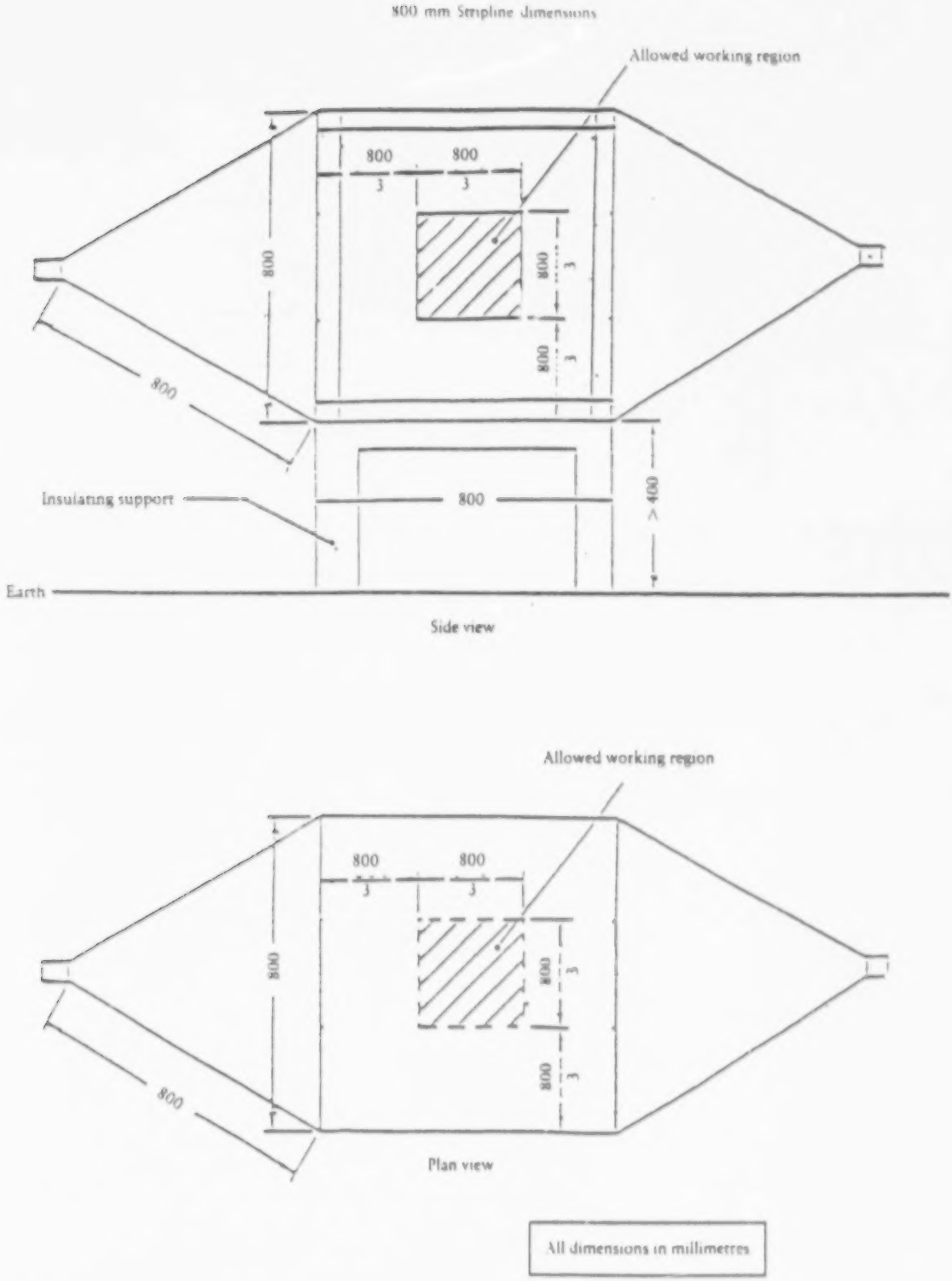


Details of stripline termination

1 = Ground plate
2 = Main loom and sensor/actuator cables
3 = Wooden frame
4 = Driven plate
5 = Insulator
6 = Test object

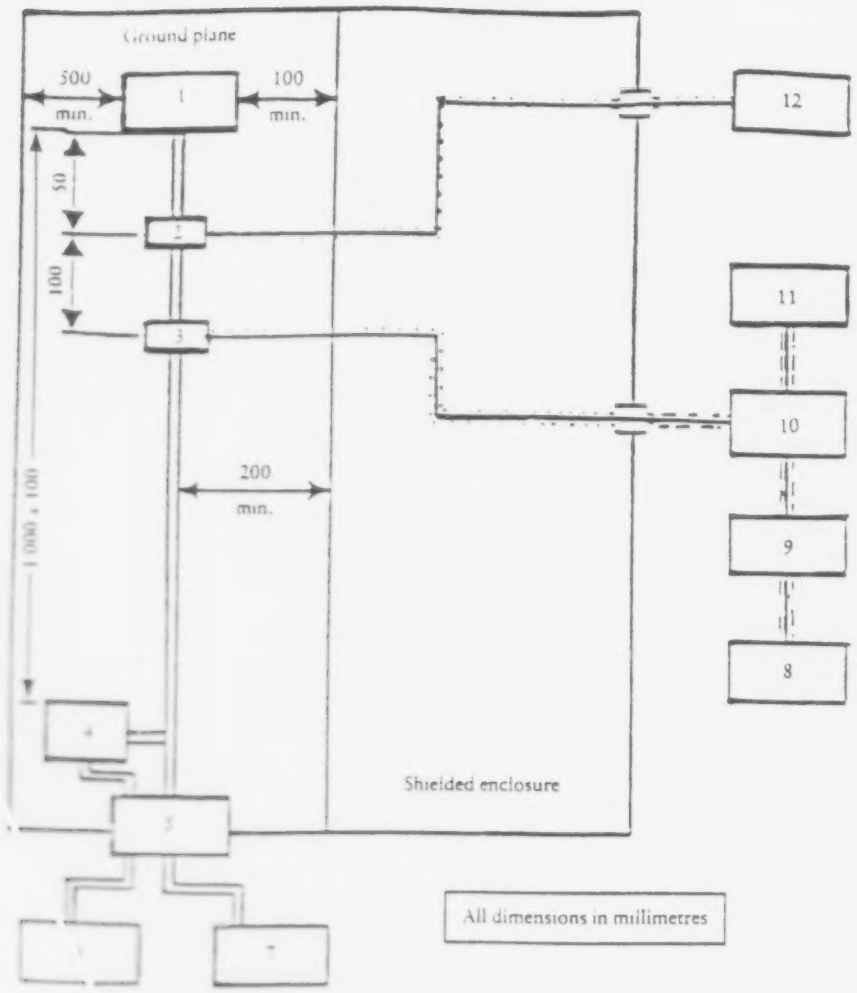
Annex 9 - Appendix 1 (cont'd)

Figure 4



Annex 9 - Appendix 2

Figure 1



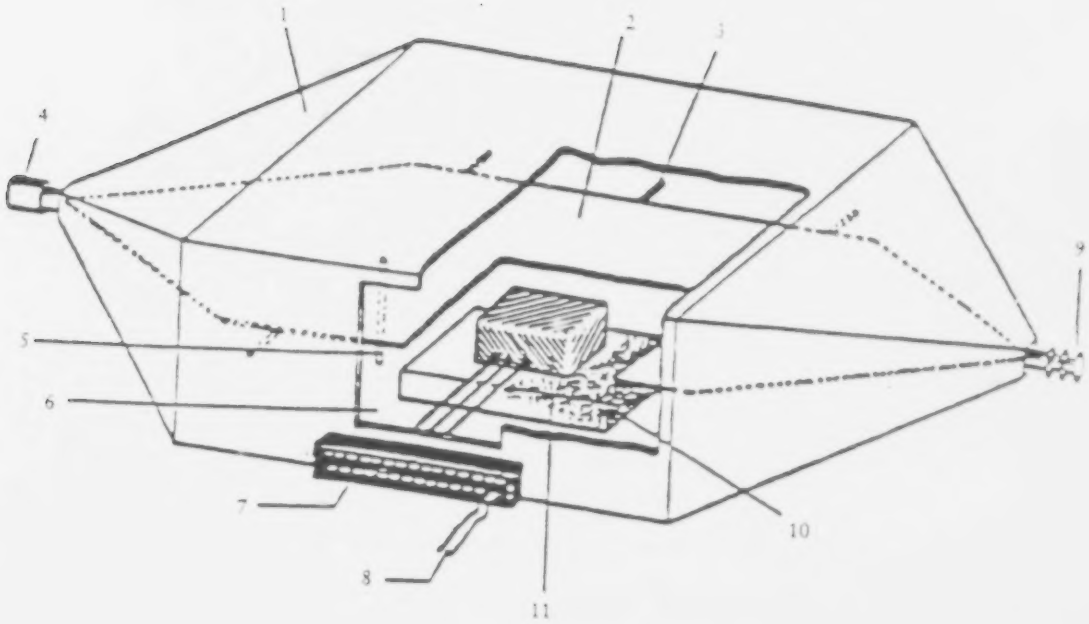
8 RF signal generator
9 Broadband amplifier
10 RF 50Ω directional coupler
11 RF or equivalent measuring system
12 Spectrum analyser or equivalent (optional)

BULK CURRENT INJECTION MEASUREMENT INSTALLATION

Annex 9 - Appendix 3

Figure 1

TEM cell testing

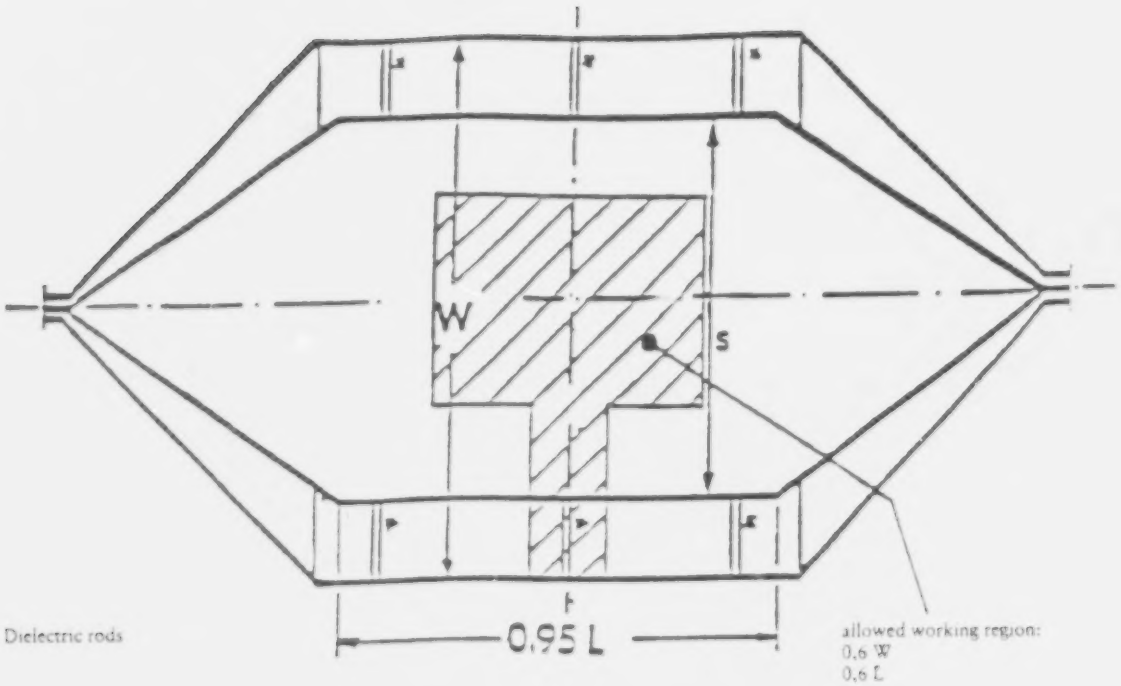


1 = Outer conducter, shield
2 = Inner conducter (septum)
3 = Insulator
4 = Input
5 = Insulator
6 = Door
7 = Socket panel
8 = Test object power supply
9 = Terminating resistance 50 Ω
10 = Insulation
11 = Test object (maximum height one third of distance between cell floor and septum)

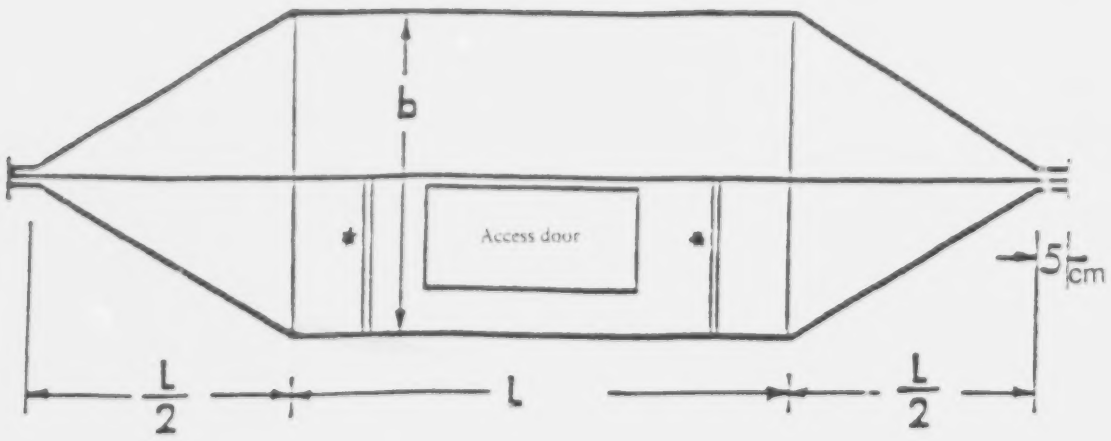
Annex 9 - Appendix 3 (cont'd)

Figure 2

TEM cell dimensions



Horizontal section view at septum



Annex 9 - Appendix 3 (cont'd)

Figure 3

The following table shows the required dimensions of a TEM cell on the basis of upper frequency limits:

Upper frequency (MHz)	Cell form factor W : b	Cell form factor L/W	Separating date b (cm)	Septum S (cm)
200	1.69	0.66	56	70
200	1.00	1	60	50

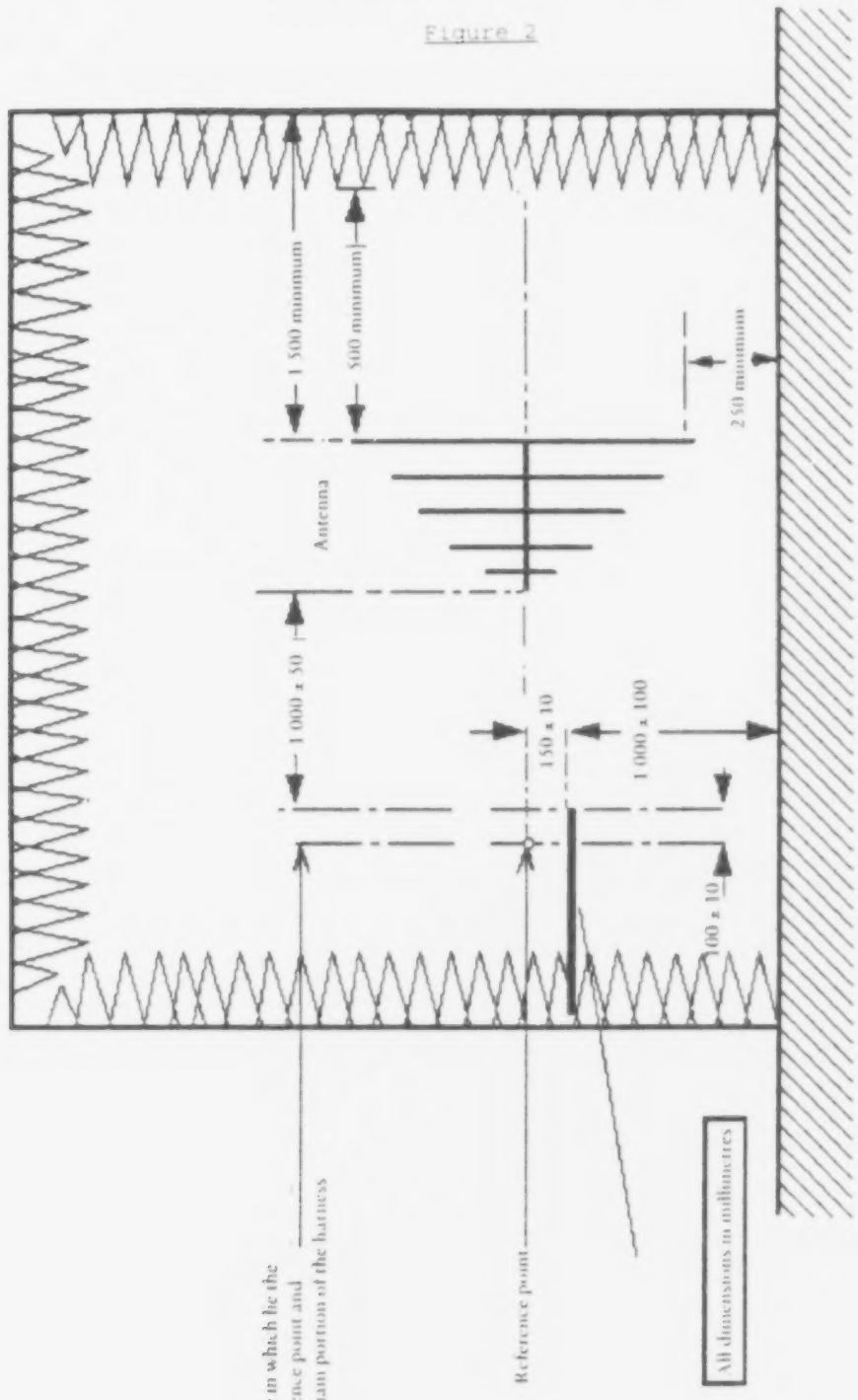
STANDARD TEM CELL DIMENSIONS

Annex 9 - Appendix 4

Figure 1

Annex 9 - Appendix 4 (cont'd)

Figure 2



Free field ESA immunity test
View of test bench plane of longitudinal symmetry